PROCEEDINGS

OF

THE CHEMICAL SOCIETY.

Vol. XXII. Nos. 303—318.

JANUARY—DECEMBER, 1906.

LONDON:
GURNEY & JACKSON, 10, PATERNOSTER ROW.
1907.

RICHARD CLAY AND SONS, LIMITED,
BREAD STREET HILL, E.C., AND
BUNGAY, SUFFOLK.

LIST OF GRANTS MADE FROM THE RESEARCH FUND DURING THE YEAR 1906.

£5 to W. Barbour: the alkylation of cellulose and polarimetric examination of the products.

£5 to H. W. Bywaters: investigation of the changes occurring in egg-white during incubation of egg.

£20 to A. W. Crossley: the reduction products of chloroketodimethyltetrahydrobenzene.

£10 to G. Dean: redetermination of the atomic weight of nitrogen by estimation of the weight of silver contained in a given weight of pure silver cyanate.

£5 to A. E. Dunstan: the investigation of the viscosity of liquid mixtures.

£5 to C. E. Fawsitt: the viscosity of fluid substances (including metals) and the physico-chemical properties of solids in different states (phases).

£10 to K. Fisher: the synthesis of sylvestrene.

£10 to A. G. Green: the constitution of synthetic colouring matters.

£10 to P. Haas: the action of nitrous acid on dimethyldihydroresorcin and its nitrogen derivatives.

£10 to V. J. Harding: the preparation of an isomeride of camphor from isonitrosocamphor.

£5 to H. Hartley: the physico-chemical properties of mixtures of pyridine and water.

£10 to H. Henstock: $\alpha\alpha\gamma$-trimethyl tricarballylic acids.

£10 to T. M. Lowry: continued studies in dynamic isomerism.

£8 to F. M. Perkin: oxidation of hydrocarbons of the benzene series.

£5 to T. S. Price: electrolytic preparation of dialkyl disulphides.

£10 to R. Robinson: synthesis of some of the more important natural colouring matters.

£12 to J. L. Simonsen: synthesis of pinene.

£5 to J. F. Spencer: electrochemical study of thallium compounds.

£10 to J. J. Sudborough: "Steric Hindrance" and polynitro-compounds.

£15 to J. F. Thorpe: conversion of benzenoid nitriles into derivatives of naphthalene.

£10 to J. F. Thorpe: the action of primary nitriles on *m*-xylylene-dinitrile.

£5 to W. B. Tuck: the spectroscopic investigation of phenyl-hydrazones.

£15 to A. E. H. Tutton: continued study of the relations between crystallographic form and chemical composition.

Total amount granted = £210.

LIST OF FELLOWS ELECTED DURING 1906

Name.	Proposed.	Elected.
Abegg, Richard	November 1st, 1906	December 6th.
Agar, Shelton Gottlieb	May 17th, 1906	July 5th.
Anderson, Robert	June 7th, 1906	,, ,,
Arup, Paul Seidelin	October 18th, 1906	December 6th.
Austin, Percy Corlett	April 5th, 1906	July 5th.
Banner, George Ernest	December 7th, 1905	February 15th.
Barker, Arthur Ernest	,, ,, ,,	,, ,,
Barrett, Ernest	March 15th, 1906	May 3rd.
Bayliss, William Heath	November 1st, 1906	December 6th.
Beckett, Richard Henry	February 15th, 1906	May 3rd.
Bell, William Edward	November 16th, 1905	February 15th.
Berry, Arthur John	May 3rd, 1906	July 5th.
Bethea, Oscar Walter	October 18th, 1906	December 6th.
Birt, Roderick Harold Capper	February 1st, 1906	May 3rd.
Blatchley, Charles Frederick Polwhele	December 7th, 1905	February 15th.
Bogue, Thomas Going Stoney	December 21st, 1905	,, ,,
Bowis, William John	May 3rd, 1906	July 5th.
Braid, Arthur Forbes	December 7th, 1905	February 15th.
Briggs, Richard Victor	January 18th, 1906	,, ,,
Broome, James Spears	October 18th, 1906	December 6th.
Byrom, Thomas Henry	,, ,, ,,	,, ,,
Calam, Harold	May 3rd, 1906	July 5th.
Caldwell, William	December 7th, 1905	February 15th.
Carmichael, John	October 18th, 1906	December 6th.
Carpenter, Percy Henry	,, ,, ,,	,, ,,
Chamberlain, Percy Garratt	March 15th, 1906	May 3rd.
Chrystall, Edwin Rodney	March 1st, 1906	,, ,,
Clarke, Reginald William Lane	December 7th, 1905	February 15th.
Cockburn, Charles Taylor	October 18th, 1906	December 6th.
Conyngham, William Boulton	December 7th, 1905	February 15th.
Cooper, Herbert Reginald	February 15th, 1906	May 3rd.
Cornwall, Reginald de Vere	July 5th, 1906	December 6th.
Courtauld, Stephen Lewis	December 21st, 1905	February 15th.
Coward, Hubert Frank	October 18th, 1906	December 6th.
Crocker, Henry Ernest	July 5th, 1906	,, ,,
Davidson, Charles	February 15th, 1906	May 3rd.
Davson, Archibald Prideaux	October 18th, 1906	December 6th.
Denton, John	May 3rd, 1906	July 5th.
Dickson, William	February 1st, 1906	May 3rd.
Dinwoodie, James Herbert	July 5th, 1906	December 6th.
Drinkwater, Lionel John	April 5th, 1906	July 5th.
Duncan, Robert K.	March 1st, 1906	May 3rd.
Durrans, Thomas Harold	November 16th, 1905	February 15th.

Name.	Proposed.	Elected.
Eaton, Bertie James	May 3rd, 1906	July 5th.
Edgell, Cecil Wyatt-	March 15th, 1906	May 3rd.
Evans, Frederick Watkins	December 7th, 1905	February 15th.
Farmer, Charles George Edgar	November 1st, 1906	December 6th.
Feilmann, Ernest	March 1st, 1906	May 3rd.
Field, Samuel	June 21st, 1906	December 6th.
Fierz, Hans Eduard	December 7th, 1905	February 15th.
Fitzgerald, Anthony Nisbet	October 18th, 1906	December 6th.
Flürscheim, Bernhard	April 5th, 1906	July 5th.
Foucar, James Louis	March 1st, 1906	May 3rd.
Foy, Peter Bertram	March 15th, 1906	,, ,,
Gardner, Edward	February 15th, 1906	,, ,,
Garvey, Richard Godfrey Hamilton	,, ,, ,,	,, ,,
Gibbs, Reginald William Malyon	June 7th, 1906	July 5th.
Glover, Walter Hamis	November 16th, 1905.	February 15th.
Gregory, Thomas William D.	May 17th, 1906	July 5th.
Grindley, Harry Sands	January 18th, 1906	February 15th.
Grubb, David Paton	November 1st, 1906	December 6th.
Gupta, Hem Chandra Dutt	March 1st, 1906	May 3rd.
Hall, Octavius	October 18th, 1906	December 6th.
Hall, Richard John	March 1st, 1906	May 3rd.
Hamer, John	November 1st, 1906	December 6th.
Hanson, H. Norman	October 18th, 1906	,, ,,
Harris, Frederick James	June 21st, 1906.	,, ,,
Hayworth, William Prince	November 16th, 1905.	February 15th.
Hedley, Edgar Percy	April 5th, 1906.	July 5th.
Herty, Charles H.	June 21st, 1906	,, ,,
Hill, Arthur Edwin	April 5th, 1906.	,, ,,
Hills, James Stuart	February 1st, 1906	May 3rd.
Hines, Charles Percy	October 18th, 1906	December 6th.
Hopkins, Frederick Gowland	April 5th, 1906.	July 5th.
Hughes, John Gerard	May 17th, 1906.	,, ,,
Irving, Henry Carlyle	December 21st, 1905.	February 15th.
Jenkinson, Ernest Arthur	May 17th, 1906	July 5th.
Johnston, Archibald McArthur	June 21st, 1906	December 6th.
Jones, Edward Rees	October 18th, 1906	,, ,,
Jones, Llewellyn Thomas	January 18th, 1906	February 15th.
Jones, William Henry Matthews	December 7th, 1905	,, ,,
Ladell, William Richard Simpson	October 18th, 1906	December 6th.
Lattey, William Tabor	February 15th, 1906.	May 3rd.
Le Rossignol, Robert	January 18th, 1906	February 15th.
McCombie, Hamilton	February 15th, 1906.	May 3rd.
McDowall, John	December 21st, 1905.	February 15th.
McIntosh, David	October 18th, 1906	December 6th.
Macdonald, Thomas	April 5th, 1906	July 5th.
Mace, William	January 18th, 1906	February 15th.
Majumdar, Tarak Nath	November 15th, 1906	December 6th.
Martin, Frederick James	June 7th, 1906.	July 5th.
Martin, George Frederick Wesley	December 7th, 1905	February 15th.
Mastin, John	October 18th, 1906	December 6th.

Name.	Proposed.	Elected.
Middleton, Alexander Edmund	November 1st, 1906	December 6th.
Mills, Herbert Arthur	June 7th, 1906	July 5th.
Morris, Arthur Higgs	November 1st, 1906	December 6th.
Mukerjee, Ram Chandra	March 15th, 1906	May 3rd.
Mummery, William Rest	May 17th, 1906	July 5th.
Murray, Thomas Jenkins	February 15th, 1906	May 3rd.
Naylor, George	October 18th, 1906	December 6th.
Newton, Arthur Percival	November 1st, 1906	,, ,,
Oliver, Edgar Gale	February 15th, 1906	May 3rd.
Ormerod, Ernest	February 1st, 1906	,, ,,
Oxland, Charles Harold	October, 18th, 1906	December 6th.
Palmer, Arthur Charles	May 17th, 1906	July 5th.
Parfitt, Samuel	January 18th, 1906	February 15th.
Parkin, John	December 21st, 1905.	,, ,,
Pearse, Leonard Edward Beard	June 7th, 1906	July 5th.
Pendlebury, Harold Lawson	April 5th, 1906	,, ,,
Pennymore, Percy George	,, ,, ,,	,, ,,
Perkins, William Hughes	December 21st, 1905.	February 15th.
Pickles, Samuel Shrowder	May 17th, 1906	July 5th.
Pitman, John Edmund	December 7th, 1905.	February 15th.
Porritt, Benjamin Dawson	November 1st, 1906.	December 6th.
Pye, Thomas Ebenezer	June 7th, 1906	July 5th.
Rawles, Walter Hansen	April 5th, 1906	,, ,,
Redgrove, Herbert Stanley	November 1st, 1906.	December 6th.
Richardson, Frederic Ion	October 18th, 1906	,, ,,
Richardson, Lawrence George	February 15th, 1906.	May 3rd.
Robinson, Reginald Ernest	October 18th, 1906	December 6th.
Rogerson, Harold	December 7th, 1905.	February 15th.
Rowsell, Philip Foale	December 21st, 1905.	,, ,,
Salmon, Frederick John	June 7th, 1906	July 5th.
Sanyal, Surendra Prasad	May 17th, 1906	,, ,,
Scouller, Walter Daly	March 1st, 1906	May 3rd.
Seaber, Willie Macro	May 17th, 1906	July 5th.
Sen, Gopal Chandra	July 5th, 1906	December 6th.
Senior, John	April 5th, 1906	July 5th.
Shepherd, Arthur Burton	May 3rd, 1906	,, ,,
Shrimpton, John Kirby	November 16th, 1905	February 15th.
Sime, Allan	May 17th, 1906	July 5th.
Simonsen, John Lionel	October 18th, 1906	December 6th.
Smith, Charles	,, ,, ,,	,, ,,
Smith, Frank	December 7th, 1905	February 15th.
Smith, Fred	May 3rd, 1906	July 5th.
Sommerville, David	February 15th, 1906.	May 3rd.
Spencer, James Frederick	March 1st, 1906	,, ,,
Sproxton, Foster	February 15th, 1906.	,, ,,
Starling, William R. R.	November 1st, 1906.	December 6th.
Storey, Francis W.	March 1st, 1906	May 3rd.
Streimer, Emanuel George	April 5th, 1906	July 5th.
Talbot, George Stanley	January 18th, 1906	February 15th
Telling, Harry George	October 18th, 1906	December 6th.
Tempany, Harold Augustine	February 15th, 1906.	May 3rd.

Name.	Proposed.	Elected.
Thorne, Emmanuel Isaac	June 21st, 1906	December 6th.
Thornton, Percy Charles	December 7th, 1905	February 15th.
Thorp, Arthur William	January 18th, 1906	,, ,,
Tonkin, Ronald William	December 7th, 1905	,, ,,
Treble, Richard Lumley	April 5th, 1906	July 5th.
Turnbull, Robert Hutchison	,, ,, ,,	,, ,,
Turner, George Augustus	March 1st, 1906	May 3rd.
Walker, Franklin Wilfred	November 16th, 1905	February 15th.
Warren, Richard Alfred	,, ,, ,,	,, ,,
Wastenays, Hardolph	December 21st, 1905	,, ,,
Watson, Frederick William	June 21st, 1906	December 6th.
Watson, John Adam	March 15th, 1906	May 3rd.
Watt, George Gordon	October 18th, 1906	December 6th.
Watt, Henry Edgar	January 18th, 1906	February 15th.
Watts, James Neil	May 17th, 1906	July 5th.
Wechsler, Elkan	December 7th, 1905	February 15th.
West, John Henry	February 1st, 1906	May 3rd.
Wheaton, Harold Joseph	November 16th, 1905	February 15th.
Wiffen, Henry John	February 1st, 1906	May 3rd.
Wightman, Charles	April 5th, 1906	July 5th.
Willett, Herbert William Mills	November 16th, 1905.	February 15th.
Willstaetter, Richard	January 18th, 1906	,, ,,
Winther, Chr.	October 18th, 1906	December 6th.
Wolfe, Ernest Edwin	November 16th, 1905	February 15th.
Wortley, Edward Jocelyn	May 17th, 1906	July 5th.
Wren, Henry	May 3rd, 1906	,, ,,
Yates, John William	December 21st, 1905.	February 15th.
Young, George	May 3rd, 1906	July 5th.

FELLOWS DECEASED, 1906.

Name.	Elected.	Died.
*Beilstein, Fedor	February 1st, 1883	October 19th, 1906.
Chandler, William H.	February 1st, 1872	November 23rd, 1906.
Claudet, Frederic Just	February 16th, 1852	April 19th, 1906.
Davis, Thomas Sebastian	January 20th, 1876	December 30th, 1906.
Edwards, Walter Henry	December 4th, 1902	January 23rd, 1906.
Foye, Martin Hugh	June 19th, 1884	unknown.
Hambly, Charles Henry Burbridge	February 3rd, 1859	July 10th, 1906.
Hepburn, John Gotch	February 21st, 1853	April 24th, 1906.
Heywood, John Sharp Cromartie	April 3rd, 1848	September 19th, 1906.
Hurst, George H.	December 3rd, 1885	February 5th, 1906.
Lyte, Farnham Maxwell	February 3rd, 1859	March 3rd, 1906.
Marsh, Charles W.	June 16th, 1881	1896.
Miller, Edmund Howd	May 6th, 1897	November 8th, 1906.
Orsman, William James	February 21st, 1884	June 21st, 1906.
Phillips, Benjamin	June 20th, 1889	August 16th, 1905.
Pitman, John Edmund	February 15th, 1906	March 5th, 1906.
Royle, Thomas	March 20th, 1862	June 1st, 1906.
Smith, Fred.	November 20th, 1890	unknown.
Smith, Thomas Davidson	April 21st, 1898	March 3rd, 1906.
Sprengel, Hermann Johann Philipp	December 1st, 1864	January 14th, 1906.
Squire, William Stevens	February 4th, 1858	May 13th, 1906.
Storey, James Ashburner	May 7th, 1891	April 27th, 1906.
Tookey, Charles	January 15th, 1855	January 3rd, 1906.
Tyson, Thomas B.	December 3rd 1885	April 27th, 1906.
Walker, Alexander, Maj.-General	January 16th, 1868	February 21st, 1905.

* Honorary and Foreign Member.

TITLES OF PAPERS COMMUNICATED TO THE SOCIETY DURING 1906.

	Page in Proceedings.	Page in Transactions.
January 18th.		
1. The refractive indices of crystallising solutions with especial reference to the passage from the metastable to the labile condition. By Henry Alexander Miers and Florence Isaac	9	413
2. The effect of constitution on the rotatory power of optically active nitrogen compounds. Part I. By Mary Beatrice Thomas and Humphrey Owen Jones	10	280
3. The determination of available plant food in soil by the use of weak acid solvents. By Alfred Daniel Hall and Arthur Amos	11	205
4. The action of ammonia and amines on diazobenzene picrate. By Oswald Silberrad and Godfrey Rotter	13	167
5. The preparation of bistriazobenzene. By Oswald Silberrad and Bertram James Smart	14	170
6. Gradual decomposition of ethyl diazoacetate. By Oswald Silberrad and Charles Smart Roy	15	179
7. Studies on nitrogen iodide. III. The action of methyl and benzyl iodides. By Oswald Silberrad and Bertram James Smart	15	172
8. Action of bromine on benzeneazo-*o*-nitrophenol. By John Theodore Hewitt and Norman Walker	16	182
9. The condensation of dimethyldihydroresorcin and of chloroketodimethyltetrahydrobenzene with primary amines. Part I. Monoamines, ammonia, aniline, and *p*-toluidine. By Paul Haas	17	187
10. Silicon researches. Part X. Silicon thiocyanate. By J. Emerson Reynolds	17	397
11. Halogen derivatives of substituted oxamides. By Frederick Daniel Chattaway and William Henry Lewis	18	155
12. Menthyl benzenesulphonate and menthyl naphthalene-β-sulphonate. By Thomas Stewart Patterson and John Frew	19	332
13. Some reactions and new compounds of fluorine. By Edmund Brydges Rudhall Prideaux	19	316
14. Contributions to the chemistry of the rare earths. Part I. By Mario Esposito	20	—
15. A synthesis of aldehydes by Grignard's reaction. By Gordon Wickham Monier-Williams	22	273
16. The action of ultra-violet light on moist and dry carbon dioxide. By Samuel Chadwick, John Edwin Ramsbottom, and David Leonard Chapman	23	—

	Page in Proceedings.	Page in Transactions.
17. A contribution to the study of stable diazo-compounds. Preliminary note. By Gilbert Thomas Morgan and William Ord Wootton	23	—
18. Triarylsulphonium bases. By Samuel Smiles and Robert Le Rossignol	24	—
19. An improved apparatus for the continuous extraction of liquids with ether. By Richard Sisson Bowman...	24	—
February 1st.		
20. Hydroxylamine-$\alpha\beta$-disulphonates (structural isomerides of hydroximinosulphates or hydroxylamine-$\beta\beta$-disulphonates). By Tamemasa Haga	29	240
21. Studies in the camphane series. Part XXI. Benzenediazo-ψ-semicarbazinocamphor and its derivatives. By Martin Onslow Forster.	31	222
22. The relations between absorption spectra and chemical constitution. Part I. The chemical reactivity of the carbonyl group. By Alfred Walter Stewart and Edward Charles Cyril Baly	33	489
23. The relation between absorption spectra and chemical constitution. Part II. The quinones and α-diketones. By Edward Charles Cyril Baly and Alfred Walter Stewart	34	502
24. The relation between absorption spectra and chemical constitution. Part III. The nitroanilines and the nitrophenols. By Edward Charles Cyril Baly, Walter Henry Edwards, and Alfred Walter Stewart.	35	514
25. The action of light on benzaldehydephenylhydrazone. By Frederick Daniel Chattaway	36	462
26. The union of chlorine and hydrogen. By Charles Hutchens Burgess and David Leonard Chapman	37	1399
27. Note on the molecular weight of epinephrine. By George Barger and Arthur James Ewins.	38	—
28. The critical temperature and value of $\frac{ML}{\Theta}$ of some carbon compounds. By James Campbell Brown	39	311
29. Slow oxidations in the presence of moisture. By Norman Smith	39	473
30. Fischer's salt and its decomposition by heat. By Prafulla Chandra Rây	40	551
31. Action of quinones on *o*-diamines, *o*-nitroaniline, *m*-nitroaniline, and 2-nitro-*p*-toluidine. A preliminary note. By James Leicester	41	—
32. Some oxidation products of the hydroxybenzoic acids. II. By Arthur George Perkin	41	251
34. Contributions to the chemistry of oxygen compounds. Part I. The compounds of tertiary phosphine oxides with acids and salts. By Robert Howson Pickard and Joseph Kenyon	42	262
34. The rapid electroanalysis of metals. Preliminary note. By Henry Julius Salomon Sand	43	—

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February 15th.		
35. Cuprous formate. By Andrea Angel	58	345
36. The solubility of triphenylmethane in organic liquids, with which it forms crystalline compounds. By Harold Hartley and Noel Garrod Thomas	59	1013
37. The spontaneous crystallisation of supersaturated solutions. By Harold Hartley	60	—
38. Preparation and properties of some new tropeines. By Hooper Albert Dickinson Jowett and Archie Cecil Osborn Hann	61	357
39. Studies in asymmetric synthesis. IV. The application of Grignard's reaction for asymmetric syntheses. By Alexander McKenzie	61	365
40. *o*-Cyanobenzenesulphonic acid and its derivatives. By A. Jamieson Walker and Elizabeth Smith	62	350
41. The condensation of dimethyldihydroresorcin and of chloroketodimethyltetrahydrobenzene with primary amines. Part II. Diamines.—*m*- and *p*-Phenylenediamines. By Paul Haas	63	387
42. A modification of the volumetric estimation of free acid in the presence of iron salts. By C. Chester Ahlum	63	470
43. The theory of alkaline development, with notes on the affinities of certain reducing agents. By Samuel Edward Sheppard	64	530
44. Resolution of 2 : 3-dihydro-3-methylindene-2-carboxylic acid into its optically active isomerides. By Allen Neville	64	383
March 1st.		
45. Studies of dynamic isomerism. Part IV. Stereoisomeric halogen derivatives of camphor. By Thomas Martin Lowry	70	1033
46. The coagulating action of colloids. Part I. By William Porter Dreaper and Alexander Wilson	70	—
47. Studies on optically active carbimides. III. The resolution of α-phenyl-α′-4-hydroxyphenylethane by means of *l*-menthylcarbimide. By Robert Howson Pickard and William Oswald Littlebury	71	467
48. Experiments on the synthesis of the terpenes. Part VIII. Synthesis of the optically active modifications of Δ^3-*p*-menthenol(8) and $\Delta^{3:8(9)}$-*p*-menthadiene. By Francis William Kay and William Henry Perkin, jun.	72	839
49. Studies in the acridine series. III. The methylation of chrysaniline. By Albert Ernest Dunstan and John Theodore Hewitt	73	482

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50. Note on the application of the electrolytic method to the estimation of arsenic in wall-papers, fabrics, &c. By Thomas Edward Thorpe	73	408
51. Nitrogen halides from camphoryl-ψ-carbamide. By Martin Onslow Forster and Hans Grossmann	74	402
52. The relation of position isomerism to optical activity. VI. The rotation of the menthyl esters of the isomeric chloronitrobenzoic acids. By Julius Berend Cohen and Henry Percy Armes	74	454
March 15th.		
53. The interaction of well-dried mixtures of hydrocarbons and oxygen. By William Arthur Bone and George William Andrew	78	652
54. The explosive combustion of hydrocarbons. By William Arthur Bone and Julien Drugman	78	660
55. The occurrence of methane amongst the decomposition products of certain nitrogenous bases as a source of error in the estimation of nitrogen by the absolute method. By Paul Haas	81	570
56. Studies on comparative cryoscopy. Part IV. The hydrocarbons and their halogen derivatives in phenol solution. By Philip Wilfred Robertson	82	567
57. The displacement of acid ions. Part I. By Alfred Francis Joseph	82	823
58. Additive compounds of arylamines with aromatic nitro-derivatives. By Charles Loring Jackson and Latham Clarke	83	—
59. Influence of substituents in the trinitrobenzene molecule on the formation of additive compounds with arylamines. By John Joseph Sudborough and Norman Picton	84	583
60. The relations between absorption spectra and chemical constitution. Part IV. The reactivity of the substituted quinones. By Alfred Walter Stewart and Edward Charles Cyril Baly	85	618
61. The constitution and properties of acyl thiocyanates. By John Hawthorne	86	556
62. A mode of formation of aconitic and citrazinic acids and their alkyl derivatives, with remarks on the constitution of aconitic acid. By Harold Rogerson and Jocelyn Field Thorpe	87	691
63. Aromatic sulphonium bases. By Samuel Smiles and Robert Le Rossignol	87	696
64. A new form of calcium chloride tube for combustion By Arthur Edwin Hill	87	—
65. The viscosity of liquid mixtures. Part III. By Albert Ernest Dunstan	89	—
66. The action of phenylpropiolyl chloride on the ketonic compounds. Part II. By Siegfried Ruhemann	89	682

	Page in Proceedings.	Page in Transactions.
April 5th.		
67. An improved apparatus for measuring magnetic rotations and obtaining a powerful sodium light. By William Henry Perkin, sen.	100	608
68. The rusting of iron. By Gerald Tattersall Moody	101	720
69. The estimation of carbon in soils. By Alfred Daniel Hall, Norman Harry John Miller, and Numa Marmu	103	595
70. Electrolysis of salts of $\beta\beta'$ dimethylglutaric acid. By James Walker and John Kerfoot Wood	104	598
71. Bromo- and hydroxy-derivatives of $\beta\beta\beta'\beta'$-tetramethylsuberic acid. By John Kerfoot Wood	104	604
72. Some new *o*-xylene derivatives. By George Stallard	104	808
73. A new solvent for gold. Preliminary note. By James Moir	105	—
74. The molecular condition in solution of ferrous oxalate. A correction. By Samuel Edward Sheppard and Charles Edward Kenneth Mees	105	—
75 Acetyl and benzoyl derivatives of phthalamide and phthalamic acid. By Arthur Walsh Titherley and William Longton Hicks	106	708
76. The dynamic isomerism of phloroglucinol. By Edgar Percy Hedley	106	730
77. Studies in asymmetric syntheses. V. Asymmetric syntheses from *l*-bornyl pyruvate. By Alexander McKenzie and Henry Wren	107	688
78. 1-Methyl*cyclo*hexylidene-(4)-acetic acid. By William Henry Perkin, jun., and William Jackson Pope	107	—
79. Condensation of benzophenone chloride with α- and β-naphthols. By George William Clough	109	771
80. The constitution of cœrulignone (cedriret). A preliminary note. By James Moir	110	—
81. A comparative crystallographic study of the perchlorates and permanganates of the alkalis and the ammonium radicle. By Thomas Vipond Barker	111	—
82. Contributions to the theory of isomorphism based on experiments on the regular growths of crystals of one substance upon those of another. By Thomas Vipond Barker	112	1122
83. Constitution of salicin. Synthesis of pentamethyl salicin. By James Colquhoun Irvine and Robert Evstafieff Rose	113	814
84. A product of the action of *iso*amyl nitrite on pyrogallol. By Arthur George Perkin and Alec Bowring Steven	113	802
85. A reaction of ellagic and flavellagic acids. By Arthur George Perkin	114	—
86. Some thio- and dithio-carbamide derivatives of ethylene-aniline and the ethylenetoluidines. By Oliver Charles Minty Davies	114	713

	Page in Proceedings.	Page in Transactions.
May 3rd.		
87. The relation between absorption spectra and chemical constitution. Part V. The *iso*nitroso-compounds. By Edward Charles Cyril Baly, Effie Gwendoline Marsden, and Alfred Walter Stewart	126	966
88. The residual affinity of coumarin as shown by the formation of oxonium salts. By Gilbert Thomas Morgan and Frances Mary Gore Micklethwait	131	863
89. Brazilin and hæmatoxylin. Part VII. Some derivatives of brazilein. By Paul Engels and William Henry Perkin, jun.	132	—
90. The action of tribromopropane on the sodium derivative of ethyl malonate. By William Henry Perkin, jun., and John Lionel Simonsen	133	—
91. Pipitzahoic acid. By James McConnell Sanders	134	—
92. The constitution of the hydroxides and cyanides obtained from acridine, methylacridine, and phenanthridine methiodides. By Charles Kenneth Tinkler	135	856
93. The constitution of ammonium amalgam. By Elizabeth Mary Rich and Morris William Travers	136	872
94. Action of light on potassium ferrocyanide. By Glyn William Arnold Foster	136	912
95. Note on the constitution of cellulose. By Arthur George Green and Arthur George Perkin	136	811
96. Some new derivatives of pinene. By Frederick Peacock Leach	137	—
97. Glutaconic and aconitic acids. By Siegfried Ruhemann	137	—
May 17th.		
98. The relation between absorption spectra and chemical constitution. Part VI. The phenylhydrazones of simple aldehydes and ketones. By Charles Cyril Baly and William Bradshaw Tuck	142	982
99. The rusting of iron. By John Trengove Nance	143	—
100. Aromatic compounds obtained from the hydroaromatic series. Part II. The action of phosphorus pentachloride on trimethyldihydroresorcin. By Arthur William Crossley and James Stuart Hills	144	875
101. Studies of dynamic isomerism. Part V. Isomeric sulphonic derivatives of camphor. By Thomas Martin Lowry and Egbert H. Magson	145	1042
102. The densities of liquid nitrogen and liquid oxygen and of their mixtures. By John Kenneth Harold Inglis and Joseph Edward Coates	146	886
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LIBRARY RULES.

1. The Library is open for consultation, and for the issue and return of books, daily from 10 a.m. to 6 p.m. (Saturdays 10 a.m. to 2 p.m.); and in the evenings of those days on which the Chemical Society meets.*

2. Fellows are not allowed to have on loan more than *six* volumes at a time, without special permission from the Librarian.

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* During the remainder of the Session of 1906–7 the Library will be open every Thursday from 10 a.m. until 9 p.m., except on those days on which the Chemical Society meets, when it will remain open until 10.30 p.m.

8. Books which have been bespoken shall circulate in the order of application.

9. Fellows shall be at liberty to retain a book one calendar month, unless, at the expiration of a fortnight, notice is received that the book is required by another Fellow, in which case it must be returned at once. Single parts of journals may not be retained longer than one week.

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12. Fellows retaining books longer than the time specified, or neglecting to return them when demanded, shall forfeit the right to borrow books from the Library until the volume or volumes be returned.

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ADDITIONS TO THE LIBRARY DURING THE YEAR 1906.

A detailed Catalogue of the Alchemical and Early Chemical Books presented to the Society by Sir Henry Enfield Roscoe, D.C.L., LL.D., F.R.S., will be found on pp. 209–233.

Aaron, *C. H.* Assaying. 2 vols. pp. 142, 170. ill. San Francisco 1900.

Abderhalden, *Emil.* Lehrbuch der physiologischen Chemie in dreissig Vorlesungen. pp. vii + 787. Berlin 1906.

Abegg, *Richard.* See **Handbuch der anorganischen Chemie.**

Abel, *J. J.* See **Journal of Biological Chemistry.**

Abney, *Sir William de Wiveleslie.* Instruction in photography. 11th edition. pp. 676. ill. London 1905.

Agricultural Journal of India. Vol. I. Calcutta 1906. (*Reference*).

Aguiar, *Alberto d'.* See **Revista de Chimica.**

Albu, *Albert,* and **Neuberg,** *Carl.* Physiologie und Pathologie des Mineralstoffwechsels nebst Tabellen über die Mineralstoffzusammensetzung der menschlichen Nahrungs- und Genussmittel sowie der Mineralbrunnen und -Bäder. pp. 247. Berlin 1906.

Alexeyeff, *P.* General principles of organic syntheses. Authorised translation with revision and additions by *J. Merritt* **Matthews.** pp. viii + 246. New York 1906.

American Electrochemical Society. Transactions. Vol. I, etc. Philadelphia 1902 +. (*Reference.*)

Aronstein, *L.* See **Stas,** *Jean Servais.*

Aschan, *Ossian.* Chemie der alicyklischen Verbindungen. pp. xlv + 1163. Braunschweig 1905.

Azo, *R. F.* See **Stapleton,** *Henry Ernest.*

Baeyer, *Adolf von.* Gesammelte Werke. Herausgegeben zur Feier des siebzigsten Geburtstages des Autors von seinen Schülern und Freunden. 2 vols. pp. cxxxii + 990, 1195. Braunschweig 1905.

Baker, *Richard T.,* and **Smith,** *Henry G.* Some West Australian eucalypts and their essential oils. (From the *Pharm. J.*, 21, 1905.)

Baumert, *Georg,* **Dennstedt,** *M.,* und **Voigtländer,** *F.* Lehrbuch der gerichtlichen Chemie. Band II. Der Nachweis von Schriftfälschungen, Blut und Sperma. pp. x + 248. ill. Braunschweig 1906.

Bayliss, *W. M.* The kinetics of tryptic action. (Reprinted from the *Archives des sciences biologiques,* **11,** 1904.)

Beam, *William.* See **Leffman,** *Henry.*

Benedicks, *Carl.* Umwandlung des Feldspats in Sericit (Kaliglimmer). (From the *Bull. Geol. Inst. Upsala,* **7,** 1906.)

—— Yttriumhaltiger Mangangranat. (From the *Bull. Geol. Inst. Upsala,* **7,** 1906.)

—— Über das Gleichgewicht und die Erstarrungsstrukturen des Systems Eisen-Kohlenstoff. (From *Metallurgie,* **3,** 1906.)

Bergtheil, *Cyril.* See **Bihar Planters' Association.**

Berkenhout, *John.* First lines of the theory and practice of philosophical chemistry. pp. xxiii + 434. London 1788.

Bernthsen, *A.* Kurzes Lehrbuch der organischen Chemie. 9th edition. Edited by *Ernst* **Mohr.** pp. xxi + 638. Braunschweig 1906.

Berthelot, *Marcellin.* Archéologie et histoire des sciences. pp. 377. Paris 1906.

Bertiaux, *L.* See **Hollard,** *A.*

Bevan, *Edward John.* See **Cross,** *Charles Frederick.*

Bihar Planters' Association. Report of the Indigo Research Station, Sirsiah (*under subsidy from the Government of Bengal*) for the year 1905—1906. By *Cyril* **Bergtheil.** pp. 29. Calcutta 1906.

Bio-chemical Journal. Edited by *Benjamin* **Moore** and *Edward* **Whitley.** Vol. I. Liverpool 1906. (*Reference.*)

Biochemische Zeitschrift. Herausgegeben von *E.* **Buchner,** *P.* **Ehrlich,** *C. von* **Noorden,** *E.* **Salkowski,** *N.* **Zuntz.** Redigiert von *C.* **Neuberg.** Band I. Berlin 1906. (*Reference.*)

Blair, *Andrew Alexander.* The chemical analysis of iron. A complete account of all the best known methods for the analysis of iron, steel, pig-iron, iron ore, limestone, slag, clay, sand, coal, coke, and furnace and producer gases. 6th edition. pp. xix + 328. ill. Philadelphia 1906.

Blount, *Bertram.* Practical electro-chemistry. 2nd Edition. pp. xi + 394. ill. London 1906.

—— Recent progress in the cement industry. A paper read before the Society of Chemical Industry on June 11th, 1906. pp. 48.

Böhm, *C. Richard.* Die Darstellung der seltenen Erden. 2 Vols. pp. xxxii + 492, viii + 484. Leipzig 1905.

Bontoux, *Émile.* See **Lewkowitsch,** *Julius.*

Booraem, *John V. V.* Internal energy, a method proposed for the calculation of energy stored within matter. pp. 144. New York 1906.

Borel, *Pierre.* Bibliotheca chimica. Seu catalogus librorum philosophicorum hermeticorum in quo quatuor millia circiter, authorum chimicorum, vel de transmutatione metallorum, re minerali, et arcanis, tam manuscriptorum, quam in lucem editorum, cum eorum editionibus, usque ad annum 1653 continentur. pp. xii + 276. Paris 1654.

Boyle, *Hon. Robert.* New experiments and observations touching cold, or an experimental history of cold, begun. To which are added an examen of antiperistasis, and an examen of Mr. Hobs's doctrine about cold. Whereunto is annexed an account of freezing, brought in to the Royal Society, by the learned Dr. C. Merret, a Fellow of it. pp. lviii + 845 + 54. ill. London 1665.

British Association for the Advancement of Science. Report of the sixth meeting, 1836. London 1837. (*Reference.*)

British Institute of Preventive Medicine. Transactions. First series. London 1897. (*Reference.*)

Brown, *S. E.* A practical chemistry note-book for matriculation and army candidates. pp. 47. ill. London 1906.

Buchner, *E.* See **Biochemische Zeitschrift.**

Carnegie, *Douglas.* Law and theory in chemistry. pp. 222. London 1894.

Caven, *Robert Martin,* and **Lander,** *George Druce.* Systematic inorganic chemistry from the standpoint of the periodic law. pp. xix + 374. London 1906.

Chemisch-technische Untersuchungsmethoden. Edited by *Georg* **Lunge.** Vol. III. pp. xxvii + 1305 + xliv. ill. Berlin 1905.

Church, *Arthur Herbert.* Church's laboratory guide. A manual of practical chemistry . . . specially arranged for agricultural students. Revised and partly rewritten by *Edward* **Kinch.** Eighth edition. pp. xvi + 349. London 1906.

—— Precious stones considered in their scientific and artistic relations. pp. x + 135. ill. London 1905.

Cohnheim, *Otto.* See **Mann,** *Gustav.*

Crookes, *Sir William.* Select methods in chemical analysis (chiefly inorganic). 4th edition. pp. xxiv + 738. ill. London 1905.

—— The wheat problem. Based on remarks made in the presidential address to the British Association at Bristol in 1898. Revised with an answer to various critics. With two chapters on the future wheat supply of the United States, by *C. Wood* **Davis** and the Hon. *John* **Hyde.** 2nd edition. pp. xii + 229. London 1905.

Cross, *Charles Frederick,* and **Bevan,** *Edward John.* Researches on cellulose. II. (1900—1905.) pp. xi + 184. London 1906.

Czapek, *Friedrich.* Biochemie der Pflanzen. 2 vols. pp. xv + 584 xii + 1027. Jena 1905.

Day, *Arthur L.* Mineral solution and fusion under high temperatures and pressures. (From the *Year Book of the Carnegie Institution of Washington*, **4**, 1905.)

Day, *Arthur L.*, and **Shepherd,** *E. S.* Quartz glass. (From *Science*, **23**, 1906.)

Dennstedt, *M.* See **Baumert,** *Georg.*

Ditte, *Alfred.* Étude générale des sels. 2 vols. pp. vii + 304, 383. Paris 1906.

Doelter, *C.* Physikalisch-chemische Mineralogie. pp. xi + 272. ill. Leipzig 1905.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 303.

Thursday, January 18th, 1906, at 8.30 p.m. Professor R. MELDOLA, F.R.S., President, in the Chair.

Messrs. J. E. Coates, A. Amos, and M. B. Jack were formally admitted Fellows of the Society.

The PRESIDENT announced that the Society had lost a distinguished Fellow in the person of Professor Hermann Johann Philipp Sprengel, Ph.D., F.R.S., who was elected in December, 1864, and died on January 14th, 1906.

It was also stated by the President that the Society was indebted to Sir Henry E. Roscoe, F.R.S., for an important donation to the Library of nearly one hundred alchemical and old chemical works of great interest and value.

Certificates were read for the first time in favour of Messrs. :

Richard Victor Briggs, Sirseah Research Station, Mozufferpore P.O., Bengal, India.
Llewellyn Thomas Jones, B.Sc., Brenig View, Tregaron.
Samuel Parfitt, 33, Partridge Road, Cardiff.
Robert Le Rossignol, B.Sc., 2, Cæsarea Place, Jersey
Arthur William Thorp, 210, Sherborne Road, Yeovil.
Henry Edgar Watt, B.Sc., 19, Summerhill Road, Dartford, Kent.
Richard Willstätter, Ph.D., Bergstrasse 25, Zürich V.

Certificates have been authorised by the Council for presentation for ballot under Bye-Law I (3) in favour of:

William Mace, of Hope, Kingston, Jamaica.
George Stanley Talbot, Ocean Island, Sydney, N.S.W.
Harry Sands Grindley, D.Sc., State University, Illinois, U.S.A.

The Council has ordered the following letter and report to be printed in the Journal and Proceedings of the Society:

GOVERNMENT LABORATORY,
CLEMENT'S INN PASSAGE,
STRAND, LONDON, W.C.
10*th November*, 1905.

GENTLEMEN,

I have the honour to transmit to you the Report of the International Committee on Atomic Weights, 1906, to which I have appended the signatures of Professors Moissan and Seubert as desired by them.

It will be seen that the Committee, for the reasons stated in the report, are not prepared to advise any immediate alteration in the values for the atomic weights given in their last report. They recommend, however, in conformity with the desires of the great majority of the Larger Committee, that the values in the table for 1906 be given on the basis of O = 16, to the exclusion of those on the basis of H = 1.

I am, Gentlemen,

Your obedient Servant,

T. E. THORPE.

The Hon. Secretaries,
The Chemical Society,
Burlington House,
London, W.

Report of the International Committee on Atomic Weights.

During the year 1905 there has been unusual activity in the determination of atomic weights, and some of the work done relates to the most fundamental values. The entire system of atomic weights is thus affected more or less profoundly, and a general revision of the table would seem to be needed within the near future. Neglecting minor investigations, the more important determinations published since our last report are briefly as follows:

Cadmium.—Atomic weight determined by Baxter and Hines

(*J. Amer. Chem. Soc.*, 1905, **27**, 222), by analysis of the chloride. Three measurements of the ratio $CdCl_2 : 2AgCl$ gave in mean Cd = 112·476. Six measurements of the ratio $CdCl_2 : 2Ag$ gave in mean Cd = 112·462. General mean of both series, 112·469; when Ag = 107·93 and Cl = 35·473. As additional determinations are promised, based upon a study of cadmium bromide, a change in the atomic weight of cadmium as given in our table may properly be deferred.

Carbon.—From the ratios published in 1904, relative to the basic acetate and acetylacetonate of glucinum, Parsons (*J. Amer. Chem. Soc.*, 1905, **27**, 1204; *Zeit. anorg. Chem.*, 1905, **46**, 215) has computed the atomic weight of carbon. The values obtained by treating the two ratios algebraically are Gl = 9·112 and C = 12·007. As the latter figure is quite independent of all previous determinations it has distinct corroborative significance.

Chlorine and Sodium.—In a very elaborate investigation upon the atomic weights of chlorine and sodium, Richards and Wells * have shown that the data furnished by Stas are affected by appreciable errors. Ten syntheses of silver chloride gave, in mean, Cl = 35·473 when Ag = 107·93. From ten measurements of the ratio Ag : NaCl, and ten of the ratio AgCl : NaCl, with the foregoing values for silver and chlorine, Na = 23·008. Stas's values are Cl = 35·455 and Na = 23·048.

The results just cited are obviously indirect, for they depend upon the atomic weight of silver. The experiments published by Dixon and Edgar † are therefore of peculiar interest, for they involve the intervention of no intermediate quantities between the atomic weights of chlorine and hydrogen. Hydrochloric acid was directly synthesised from weighed amounts of hydrogen and chlorine, and nine concordant determinations gave, in mean, Cl = 35·195, ± 0·0019, referred to the hydrogen standard. With O = 16, Cl becomes 35·463, a value nearly midway between that found by Stas and the new figure given by Richards and Wells. Considering the difficulties of the work, the agreement between this and the previous investigations is as close as could be reasonably expected.

Gadolinium.—Urbain (*Compt. rend.*, 1905, **140**, 583), from ten analyses of the octohydrated sulphate, finds Gd = 157·23; when H = 1·007 and S = 32·06. This value is more than a unit higher than that given in the table, and is probably more trustworthy.‡

* Published by the Carnegie Institution of Washington, 70 pp., April, 1905. See also *J. Amer. Chem. Soc.*, 1905, **27**, 459.

† *Chem. News*, 1905, **91**, 263. Memoir read before the Royal Society.

‡ See Eberhard, *Zeit. anorg. Chem.*, 1905, **45**, 374; on the spectroscopic purity of the rare earth oxides studied by Urbain and others.

Iodine.—Baxter has continued his research of 1904 upon the atomic weight of iodine, and has published a second memoir upon this subject (*J. Amer. Chem. Soc.*, 1905, **27**, 876). First, from eight conversions of silver iodide into bromide, by heating in bromine, he found I = 126·985. Two series of measurements, of five experiments in each, of the ratio AgI to AgCl, gave respectively 126·982 and 126·984. Eight determinations of the direct ratio between silver and iodine, weighed separately, gave in mean 126·987. Five determinations of the ratio I : AgI gave 126·983, and four of the ratio Ag : AgI gave 126·989. The average of all six series is I = 126·985; when Ag = 107·93, Cl = 35·473, and Br = 79·955. The last of these antecedent values was checked by a direct comparison of AgBr with AgCl, and the mean of six experiments gave Br = 79·953. The value previously found by Baxter was 126·975 for iodine, and the difference is partly due to his use, in the later investigation, of the new figure obtained for chlorine by Richards and Wells. The iodine work, therefore, is confirmatory of the latter.

Nitrogen.—R. W. Gray, in a preliminary notice (*Proc.*, 1905, **21**, 156), gives the results of his experiments upon nitric oxide. Ten determinations of the density of the gas, corrected by D. Berthelot's formula, give a molecular weight of 30·005, whence N = 14·005. Six analyses of nitric oxide, effected by burning finely-divided nickel in it, gave N = 14·006. The investigation was to be continued farther.

Guye, in an interesting lecture before the Chemical Society of Paris,* has given a complete summary of the researches relative to this atomic weight, which have been conducted by him and his associates at Geneva. He also discusses, somewhat fully, all previous determinations of the constant, and concludes, mainly from the physical evidence, that the atomic weight of nitrogen is not far from 14·01, and that the value 14·04, obtained by Stas, is no longer tenable. Going still farther, he reverses the ordinary gravimetric ratios from which the accepted atomic weight of nitrogen was derived, and, applying to them the new value for N, he deduces the atomic weight of silver. The latter is thus reduced from 107·93 to below 107·89, ranging even as low as 107·871. For these low values Guye cites much confirmatory evidence, which is not to be lightly disregarded. To this point we shall recur later.

Potassium.—Atomic weight redetermined by Archibald (*Trans. Roy. Soc. Canada*, Series 2, 10, section iii, p. 47) through analysis of the chloride. Four measurements of the ratio AgCl : KCl gave K = 39·139, and four of the ratio Ag : KCl gave 39·140; when Ag = 107·93 and Cl = 35·455. If Cl = 35·473, then K becomes 39·122.

* *Bull. Soc. Chim.*, Aug. 5, 1905, with independent pagination. Compare Richards, *Proc. Amer. Phil. Soc.*, 1904, **43**, 116.

Silicon.—W. Becker and J. Meyer (*Zeit. anorg. Chem.*, 1905, **43**, 251; **46**, 45) have determined the atomic weight of silicon by conversion of the chloride into the oxide. Eight determinations were made, and, in sum, 46·82400 grams of $SiCl_4$ gave 16·58236 grams of SiO_2. Hence, with Cl = 35·45, Si = 28·207. With the Richards-Wells value for chlorine, 35·473, Si becomes 28·257. Additional determinations by a different method are promised. This paper is preceded by an essay by Meyer on the calculation of atomic weights (*ibid.*, p. 242), which deserves careful consideration.

Strontium.—From four measurements of the ratio $2Ag : SrCl_2$, Richards (*Proc. Amer. Acad.*, 1905, **40**, 603) finds Sr = 87·661, when Ag = 107·93 and Cl = 35·473. This confirms the earlier value derived by Richards from experiments upon strontium bromide.

Tellurium.—Gallo (*Atti Accad. Lincei*, 1905, [v], **14**, 23 and 104) have determined electrolytically the ratio between silver and tellurium. From twelve experiments, in mean, Te = 127·61, when Ag = 107·93. Incidentally to this work, as a check upon the method employed, four comparisons between silver and copper were made. In mean, Cu = 63·58.

Thorium.—R. J. Meyer and Gumperz (*Ber.*, 1905, **38**, 817) have attempted to separate ordinary thorium into fractions of different atomic weight, and have failed to verify the observations of Baskerville. The fractions obtained by various processes gave atomic weights varying from 232·2 to 232·7, values which are essentially identical with that given in the table.

From the foregoing summary of results, it becomes evident that a far-reaching series of changes will soon be needed in our system of atomic weights. A change in chlorine or nitrogen implies many other changes in the table, and if the accepted value for silver should be modified the alterations would be most sweeping. The atomic weights of silver, chlorine, and bromine enter into the calculation of nearly all other atomic weights, and form, so to speak, the platform upon which the entire structure stands.

The changes, however, which are suggested at present, are not final. Work is in progress in several laboratories which may confirm or modify many of the accepted values, and until that work is finished, at least so far as the fundamental data are concerned, it is wisest for us to suspend judgment and await developments. Were we to reconstruct the table of atomic weights on the basis of the evidence now before us, we should do it imperfectly, and a new revision would be demanded next year or the year after. Confusion would inevitably follow. Fortunately, the matter is not urgent, for the corrections which now seem desirable are not large, and the existing figures are accurate enough for all ordinary purposes. We therefore recommend

that the table for 1905 be continued in use without change during 1906, even although some modifications are theoretically desirable. A year hence we shall be in a better position for a critical adjustment of the data, and no harm can follow from the delay. In accordance with the expressed wish of a majority of the larger committee, we also recommend that the table based upon the oxygen standard be made official. So far as this committee is concerned, the private opinions of its members will be subordinated to the desires of the majority, and the table referred to hydrogen will no longer appear as a part of its report.

For the present, a few suggestions may not be unacceptable, which follow from an examination of the lecture by Guye. Rayleigh, Leduc, Guye, Gray, and others, from their studies of nitrogen and its oxides, have accumulated a mass of strong evidence in favour of a lower value for nitrogen. The data furnished by Stas, on the other hand, point to the higher value which has heretofore been generally adopted. Can we abandon the one in favour of the other, and accept the new figure without reserve?

On behalf of the new figure for nitrogen, we must admit that the determinations are remarkably concordant, and that they rest upon a direct comparison of the element with oxygen. The Stas values, with their confirmations by other chemists, are also very concordant, but they are indirect. They all rest primarily upon the atomic weights of silver, chlorine, and bromine, and these were connected with oxygen through experiments upon chlorates and bromates. Our whole system of atomic weights, with only a few exceptions, is based to-day upon the analyses of several oxyhalogen salts. Their accuracy is assumed, and all anomalies which appear in determinations based upon other lines of research are commonly ascribed to undiscovered errors. The assumption may be sustained, but it is not yet beyond the reach of criticism.

Consider, for example, the well-known ratio $Ag : AgNO_3 = 100 : 157{\cdot}149$. If $Ag = 107{\cdot}93$, as determined through the analyses of chlorates and bromates, then $N = 14{\cdot}037$, or $14{\cdot}04$ as given in our table. If, on the other hand, $N = 14{\cdot}009$, as given by Guye, Ag becomes $107{\cdot}881$. The difference between the two values for silver evidently represents a difference in our methods of connecting the element with oxygen, the latter being taken as the standard. For each method strong arguments are possible, and for each value other corroborative testimony can be cited. Neither procedure is wholly free from objections, and the final conclusion, therefore, is one of uncertainty. We cannot safely reject either line of evidence, nor can we accept one as surely more exact than the other. Concordant values for silver can be derived from either method of discussion, as

Guye has shown, and through them the entire system of atomic weights is affected.

In this condition of affairs, the position of the committee can only be one of conservatism. It is better to retain the table we have until at least some of the doubts which now affect it have been eliminated. It seems to be essential that the foundations of the atomic weight table should be both broadened and strengthened, and that new lines of research connecting the fundamental values with oxygen shall be investigated. Some work of this kind is already promised from the laboratory of Harvard University, to be carried out by Richards and his colleagues, but that need not exclude other activities. It is to be hoped that a number of investigators may take up the consideration of this problem, and that the methods of attack upon it may be multiplied. The careful study of such salts as the sulphates, carbonates, and nitrates might perhaps be profitable. Whether the organic salts of silver could be utilised for good atomic weight determinations is still uncertain.

F. W. Clarke.
Henri Moissan.
Karl Seubert.
T. E. Thorpe.

1906.

International Atomic Weights.

		O=16.
Aluminium	Al	27·1
Antimony	Sb	120·2
Argon	A	39·9
Arsenic	As	75·0
Barium	Ba	137·4
Bismuth	Bi	208·5
Boron	B	11
Bromine	Br	79·96
Cadmium	Cd	112·4
Cæsium	Cs	132·9
Calcium	Ca	40·1
Carbon	C	12·00
Cerium	Ce	140·25
Chlorine	Cl	35·45
Chromium	Cr	52·1
Cobalt	Co	59·0
Columbium	Cb	94
Copper	Cu	63·6
Erbium	Er	166
Fluorine	F	19
Gadolinium	Gd	156
Gallium	Ga	70
Germanium	Ge	72·5
Glucinum	Gl	9·1
Gold	Au	197·2
Helium	He	4
Hydrogen	H	1·008
Indium	In	115
Iodine	I	126·97
Iridium	Ir	193·0
Iron	Fe	55·9
Krypton	Kr	81·8
Lanthanum	La	138·9
Lead	Pb	206·9
Lithium	Li	7·03
Magnesium	Mg	24·36
Manganese	Mn	55·0
Mercury	Hg	200·0
Molybdenum	Mo	96·0

		O=16.
Neodymium	Nd	143·6
Neon	Ne	20
Nickel	Ni	58·7
Nitrogen	N	14·04
Osmium	Os	191
Oxygen	O	16·00
Palladium	Pd	106·5
Phosphorus	P	31·0
Platinum	Pt	194·8
Potassium	K	39·15
Praseodymium	Pr	140·5
Radium	Rd	225
Rhodium	Rh	103·0
Rubidium	Rb	85·5
Ruthenium	Ru	101·7
Samarium	Sm	150·3
Scandium	Sc	44·1
Selenium	Se	79·2
Silicon	Si	28·4
Silver	Ag	107·93
Sodium	Na	23·05
Strontium	Sr	87·6
Sulphur	S	32·06
Tantalum	Ta	183
Tellurium	Te	127·6
Terbium	Tb	160
Thallium	Tl	204·1
Thorium	Th	232·5
Thulium	Tm	171
Tin	Sn	119·0
Titanium	Ti	48·1
Tungsten	W	184
Uranium	U	238·5
Vanadium	V	51·2
Xenon	Xe	128
Ytterbium	Yb	173·0
Yttrium	Yt	89·0
Zinc	Zn	65·4
Zirconium	Zr	90·6

Of the following papers, those marked * were read:

*1. "**The refractive indices of crystallising solutions with especial reference to the passage from the metastable to the labile condition.**" **By Henry Alexander Miers and Florence Isaac.**

The authors found that the refractive index of a strong solution of sodium nitrate, measured at intervals while the liquid cools, rises to a maximum value and then falls, crystals appearing before the maximum is reached. If the solution is stirred during the process, the fall is very rapid and is accompanied by a profuse shower of crystals. Other solutions (for example, alum, sodium chlorate, sodium thiosulphate, ammonium oxalate) behave in the same way. There are always two periods of crystallisation: a first, in which a few crystals are growing gradually; a second, in which many crystals appear spontaneously; so that in the latter the increase of index due to cooling is more than compensated by the decrease due to weakening of the solution. The authors regard these as being undoubtedly the metastable and labile states. This view is confirmed by the behaviour of the same solutions enclosed in sealed tubes and shaken continuously; if the salt is completely dissolved, they cannot be made to crystallise until they have assumed a temperature corresponding to the maximum refractive index. By means of auxiliary experiments, the refractive indices are interpreted as concentrations, and each series of observations is expressed as a curve with concentrations for ordinates and indices for abscissæ; the maximum points of the curve lie on a new curve, the "supersolubility curve" denoting the limit between the metastable and labile conditions; the same curve is given by the temperatures at which different solutions yield crystals when shaken in sealed tubes; it shows the highest temperature at which any given supersaturated solution can crystallise spontaneously. It is necessary in the case of sodium chlorate to employ friction as well as motion, by enclosing some insoluble substance in the tube, in order to make the crystals appear as soon as the supersolubility curve is reached.

In the experiments in open vessels, the refractive index is measured by means of a totally reflecting glass prism immersed in the liquid; the crystals which appear before the labile state is reached are doubtless introduced with the dust of the air, or are due to evaporation and cooling at the edges and surface of the liquid, which reduces the solution locally to the labile state.

Discussion.

Dr. Tutton said that it appeared to him that these interesting experiments lead to two important results. Firstly, that determinations of the refractive index of highly concentrated solutions afford valuable indications of the limits of the so-called "labile" and "metastable" conditions, and a new means of exploring the region of supersaturation. Secondly, that this new method of research may be of value in cases of dimorphism, where one of the forms only is commonly obtained, by throwing some light on the reasons for the predisposition to crystallise in that particular form rather than in the other.

Sir William Ramsay asked whether Professor Miers had made any experiments on the condition of water cooled to below 4° from a high temperature, and produced from melted ice, but not allowed to rise above 4°. Experiments made by Mr. Wilsmore in his laboratory had failed to show any difference in density of different specimens of water thus prepared; but he understood that Dr. Chichester Bell had been successful in detecting different values for γ, the ratio of the specific heats at constant volume and constant pressure, in two such specimens of water; γ was determined by an acoustical method.

Mr. Pickering said that the authors should be congratulated on having obtained a method of studying solutions at that critical period of their existence when crystallisation is occurring, and he suggested that it might be of advantage to study pure liquids in the same way.

In reply to a question from Prof. Armstrong, Prof. Miers said that the experiments reveal a state of the solution in which a sudden access of spontaneous crystallisation occurs, and this condition is indicated by the term "labile." He hoped to extend the experiments to water and other pure substances.

***2. "The effect of constitution on the rotatory power of optically active nitrogen compounds. Part I." By Mary Beatrice Thomas and Humphrey Owen Jones.**

The resolution of a set of optically active nitrogen compounds and the examination of the rotatory power of their salts in dilute aqueous solution have been made in order to find the rotatory power of the ions. This property of the ions is free from many of the disturbing influences such as molecular association and nature of solvent, which affect the rotatory power of non-electrolytes, and render comparable results so difficult to obtain with this class of compound.

Relations between rotatory power and constitution ought therefore to become more evident in the case of ions than of complete molecules.

Two homologous series, each consisting of five compounds, were chosen for examination; in one series, three of the hydrogen atoms in the ammonium ion are replaced by the phenyl, methyl, and allyl groups, whilst the fourth atom of hydrogen is replaced successively by the ethyl, *n*-propyl, *iso*propyl, *iso*butyl, and *iso*amyl groups; in the other series, the phenyl, methyl, and benzyl groups are present with the same five aliphatic groups. The ethyl compound of the latter series has already been described by one of us, and Wedekind has resolved the *n*-propyl and *iso*butyl compounds. The compounds originally resolved by Pope and Peachey, namely, the phenylbenzylmethylallyl-ammonium salts, fall naturally into both these series.

The following are the values of $[M]_D$ for the ions at 15°:

Phenylmethylallyl series. Ethyl 16°, *n*-propyl 106°, *iso*propyl 1 03°, *iso*butyl 55°, *iso*amyl 18°, benzyl 167°.

Phenylmethylbenzyl series. Ethyl 19·4°, *n*-propyl 299°, *iso*propyl 398°, *iso*butyl 323°, *iso*amyl 287°.

In all cases examined, the value of $[M]_D$ for the basic ion is diminished slightly with increasing temperature between 10° and 50°.

In both series there is a well-marked maximum of rotatory power at the second member of the series, the propyl or *iso*propyl compound; in the allyl series, the rotatory power of these two compounds is almost identical, but in the benzyl series the propyl compound occupies quite a different position.

The application of Guye's hypothesis to the case of nitrogen gives an expression for the rotatory power of the compound in terms of the masses of the substituting groups which does not account for the results in an entirely satisfactory manner.

In those cases where the active iodide could be recovered its rotatory power was examined in solution in alcohol and in chloroform.

The rotatory power was always greater in chloroform than in alcohol, and the iodides invariably underwent racemisation in chloroform solution with very different velocities.

***3. "The determination of available plant food in soil by the use of weak acid solvents." By Alfred Daniel Hall and Arthur Amos.**

The authors have investigated the effect of repeating the attack of weak acid solvents on soils of known history derived from the Rothamsted experimental plots. After the first extraction, the soil is washed and again extracted with the same solvent, the process being repeated several times. The solvents employed were water charged with carbon dioxide and a 1 per cent. solution of citric acid.

The first extraction does not remove the whole of the phosphoric

acid capable of going into solution in the given solvent, the reaction is a reversible one, and a position of equilibrium is attained between the phosphoric acid in solution and the bases in the soil.

With carbon dioxide and water, the position of equilibrium is approximately constant for successive extractions and is characteristic of the manurial history of the soil. With dilute citric acid, the phosphoric acid going into solution falls for the first four or five extractions and then becomes approximately constant. In the case of the Rothamsted soils, which have been continuously manured with superphosphate, the phosphoric acid going into solution decreases logarithmically, indicating that the amount dissolved is proportional to the active mass of a particular compound present in the soil, six-tenths of which become dissolved at each extraction. The total quantity of this compound is equal to the phosphoric acid supplied as manure during the last 50 years, less that which has been removed in the crop.

Soils which have received more varied compounds of phosphoric acid as manure do not show the same regular decrement in the amounts passing into solution, indicating the presence in the soil of a number of compounds of phosphoric acid of differing solubility.

The investigation lends no support to the theory that all soils establish in the soil water a solution of phosphoric acid of approximately the same composition and independent of the fertilisers the soil receives.

Discussion.

Dr. Dyer said the paper was one of much interest; for whilst in his original examination of these soils he had, by one extraction only with citric acid, found in the surface soil the greater part of the calculated accumulation of phosphoric acid due to the manuring, the authors had now, by their supplementary extractions with the same reagent, discovered the remainder almost with the accuracy of an accountant's balance sheet—except in the case of the dunged plots. In three cases, the earlier investigation showed that some of the phosphoric acid had gone down into the lower depths of the subsoil, and, furthermore, the actual quantity of phosphoric acid added in the dung could only be vaguely guessed. It was satisfactory to hear that the authors still considered that for practical analytical purposes one extraction sufficed.

Mr. Pickering asked whether the influence of the volume of solution used—which would mean a variation in the proportions of citric acid to soil—had been investigated, also whether the effect of pulverisation of the soil had been examined, for he had found that the amount of potash and iron dissolved by citric acid from a soil depended largely on the degree of fineness to which the soil had been reduced.

In reply, Mr. HALL said that in all cases the amount of citric acid solution had been kept constant, 1 litre to 100 grams of the soil. Soil which passed the 3 mm. sieve was used without any grinding, but as there were other reasons for supposing that the soil phosphates were almost wholly found on the outside of the soil particles, grinding should not make much difference to the phosphoric acid results.

***4. "The action of ammonia and amines on diazobenzene picrate."**
By Oswald Silberrad and Godfrey Rotter.

When diazobenzene picrate is acted on by ammonia gas, it rapidly loses the characteristics of a diazo-salt and forms a dark red product.

Two possibilities presented themselves, namely: (1) the formation of ammonium picrate, accompanied by further reactions between the diazo-complex and the excess of ammonia; (2) an intramolecular transformation of the diazo-picrate to trinitrobenzeneazophenol, somewhat analogous to the diazoaminobenzene transformation.

The intense red colour of the product appeared to lend some probability to the latter assumption, but an examination of the reaction completely disproved the presence of azo-compounds. The products proved to consist mainly of ammonium picrate, and diphenylamine, aniline, and phenol were also detected. Thus, the course of the reaction is evidently represented by the equations: $2C_6H_5\cdot N_2\cdot O\cdot C_6H_2(NO_2)_3 + 3NH_3 = (C_6H_5N_2)_2NH + 2NH_4\cdot O\cdot C_6H_2(NO_2)_3$; $(C_6H_5N_2)_2NH = (C_6H_5)_2NH + 2N_2$; $(C_6H_5N_2)_2NH + H_2O = C_6H_5\cdot NH_2 + C_6H_5\cdot OH + 2N_2$.

Other compounds occurred in small quantities as the result of secondary reactions. When treated with aniline, diazobenzene picrate gives rise to aniline picrate and aminoazobenzene; the latter compound evidently resulted from a transformation of diazoaminobenzene; thus, in this case, the reaction takes place as follows: $C_6H_5\cdot N_2\cdot O\cdot C_6H_2(NO_2)_3 + 2C_6H_5\cdot NH_2 = C_6H_5\cdot N_2\cdot NH\cdot C_6H_5 + C_6H_5\cdot NH_3\cdot O\cdot C_6H_2(NO_2)_3$.

DISCUSSION.

Dr. MORGAN stated that in conjunction with Mr. Wootton he had studied the picrates of diazo-compounds, and especially the stable product derived from *p*-aminobenzanilide (see p. 23). This compound was precipitated even in strongly acid solution and was, therefore, in all probability a diazonium derivative. They had not detected *syn*- and *anti*-isomerism in this series. It would be interesting to know whether the more explosive diazobenzene picrate was a diazo-compound or a diazonium salt.

In reply, Dr. SILBERRAD said that the comparative stability of

diazobenzene picrate was remarkable considering its constitution, but, nevertheless, he regarded it as a true diazonium salt. Under these conditions, it seemed improbable that *syn*- and *anti*-derivatives could be prepared, which was in accord with Dr. Morgan's observations on similar compounds.

*5. "The preparation of bistriazobenzene."
By Oswald Silberrad and Bertram James Smart.

The explosive properties of bistriazobenzene have hitherto precluded the verification of its composition by analysis; for this reason, a reinvestigation of the compound has been undertaken, and at the same time the method for its preparation has been somewhat modified.

Griess (*Ber.*, 1888, **21**, 1559) took the oxamic acid of *p*-phenylenediamine as the starting point for the preparation of this compound; in the present work, however, it has been found advantageous to proceed from *p*-aminoacetanilide. The successive steps of the preparation are seen from the following series of intermediate products: *p*-aminoacetanilide, acetyl-*p*-aminodiazobenzene perbromide, *p*-aminotriazobenzene, *p*-triazodiazobenzene perbromide, bistriazobenzene.

Acetyl-p-*aminodiazobenzeneperbromide*, $CH_3 \cdot CO \cdot NH \cdot C_6H_4 \cdot N_2Br_3$, crystallises in small, yellow plates (m. p. 126°) with decomposition.

p-*Aminotriazobenzene*, $NH_2 \cdot C_6H_4 \cdot N_3$, was prepared by the hydrolysis of acetyl-*p*-aminotriazobenzene with caustic potash, previously unsuccessfully attempted by Rupe and von Majewski (*Ber.*, 1900, **33**, 3406).

Bistriazobenzene, $N_3 \cdot C_6H_4 \cdot N_3$ (m. p. 83°) explodes on heating; its analysis was, however, successfully carried out under diminished pressure, and gave results which agreed with the above formula.

Discussion.

Dr. Forster inquired whether *p*-bistriazobenzene has a distinctive odour, because he had noticed that *m*- and *p*-nitrophenylazoimides have a faint odour of anise, which is more marked in the case of *p*-tolylazoimide and *p*-chlorophenylazoimide, whilst in the case of *p*-methoxyphenylazoimide the odour is comparable with that of anethole itself, being less sweet and more pungent than the perfume of the last-named substance. Curiously enough, *o*-nitrophenylazoimide is odourless.

In reply, Dr. Silberrad said that he had noticed an anise-like odour, but considered the smell more similar to that of a nitro-compound, and suggested that this might be regarded as an argument

in favour of the formula $-N<^{O}_{O}$ for nitro-derivatives analogous to $-N<^{N}_{N}$ of triazo-compounds.

***6. "Gradual decomposition of ethyl diazoacetate." By Oswald Silberrad and Charles Smart Roy.**

When ethyl diazoacetate is exposed to light at the ordinary temperature, a gradual evolution of nitrogen occurs, and after the space of several years, thick, colourless, rhombic crystals resembling cane sugar gradually make their appearance. On examination, this compound proved to be the triethyl ester of 4 : 5-dihydro-3 : 4 : 5-pyrazoletricarboxylic acid.

Subsequent work showed that the same compound can readily be produced by warming ethyl diazoacetate with copper dust. In both cases, the reaction is evidently due to the intermediate formation of fumaric or maleic esters.

This view is confirmed by the work of Buchner and Witter, who prepared the trimethyl ester by the action of the corresponding ester of fumaric or maleic acid on methyl diazoacetate (*Annalen*, 1895, 273, 239).

***7. "Studies on nitrogen iodide. III. The action of methyl and benzyl iodides." By Oswald Silberrad and Bertram James Smart.**

The action of methyl iodide.—Previous experiments by Stahlschmidt (*Poggendorff's Ann.*, 1863, 119, 421) on the interaction of nitrogen iodide with methyl iodide led him to represent the reaction by the following equation: $2NI_3 + 6CH_3I = N(CH_3)_4I_5 + NH_4I + 2CHI_3$. Since the formula here assumed for nitrogen iodide is not in accord with that proved by Chattaway (*Proc.*, 1899, 17, 20; *Amer. Chem. Soc.*, 1900, 23, 363, &c.), or with the constitution $NI_3{\cdot}NH_3$, established by one of the authors (Silberrad, Trans., 1905, 87, 55 and 66), renewed experiments have been carried out on the above reaction. The formation of tetramethylammonium pentaiodide as observed by Stahlschmidt was confirmed in the present work, and its nature established by its preparation from tetramethylammonium iodide and iodine. Iodoform was not, however, as he believed, a product of the reaction between nitrogen iodide and methyl iodide, but resulted from the alcohol, present in his experiments. In the present work, alcohol was excluded; the nitrogen iodide was prepared from ammonia and iodine chloride and was allowed to react with excess of methyl iodide under water. The products found were tetramethylammonium penta-

iodide, ammonium iodide and iodate, and free iodine. The quantities of all these products were determined and the reaction was proved to proceed almost quantitatively according to the following equation:

$$6N_2H_3I_3 + 24CH_3I + 3H_2O = 6N(CH_3)_4I_5 + 5NH_4I + 3I_2 + NH_4 \cdot IO_3.$$

No compounds corresponding to Stahlschmidt's di-iodomethylamine or butyric acid were produced.

Action of benzyl iodide.—This iodide was found to react readily with moist nitrogen iodide. The nature of products, however, depends on the proportion of benzyl iodide taken, bright green or garnet-red crystals being deposited according to the conditions of the experiment. These proved both to be periodides of tribenzylamine.

Tribenzylammonium pentaiodide, $N(C_7H_7)_3HI_5$, which forms bright green crystals melting at 121—122°, is sparingly soluble in alcohol, and undergoes a slight decomposition on recrystallisation.

Tribenzylammonium di-iodide, $N(C_7H_7)_3HI_2$, crystallises in garnet-red prisms melting at 115—116°; it dissolves more readily in alcohol than the pentaiodide, and can be more easily obtained in the crystalline condition.

The pentaiodide can be readily converted to the red di-iodide by the partial abstraction of its iodine by shaking with potassium iodide solution. Conversely, the di-iodide can be converted into pentaiodide by treatment with alcoholic iodine. Both compounds can also be obtained direct from tribenzylamine by the addition of the required quantity of iodine to the iodide of the base.

*8. "Action of bromine on benzeneazo-*o*-nitrophenol."
By John Theodore Hewitt and Norman Walker.

By the action of bromine on 4-benzeneazo-2-nitrophenol in presence of glacial acetic acid and fused sodium acetate, the 6-hydrogen atom is replaced. The constitution of the resulting compound, which when pure melts at 154·5—155°, was confirmed by fission with excess of fuming nitric acid. The resulting *p*-nitrophenyldiazonium nitrate was isolated by conversion into *p*-nitrobenzeneazo-*β*-naphthol, whilst 1·5 grams of 2-bromo-4 : 6-dinitrophenol, melting before purification at 116° (uncorr.), were obtained instead of the theoretical amount of 1·6 grams from 2 grams of the azophenol. Körner gives the melting point of bromodinitrophenol as 118°.

The following derivatives of benzeneazobromonitrophenol have been analysed: *sodium* and *potassium* salts, *acetyl* derivative (m. p. 137°), and *benzoyl* derivative (m. p. 131°). 4-p-*Toluneazo*-2-*nitro*-6-*bromophenol* was prepared in a similar manner from *p*-toluneazonitrophenol;

it melts at 161°. Fuming nitric acid furnishes 2-bromo-4 : 6-dinitrophenol as a product of fission; its *acetyl* derivative melts at 124°, the *benzoyl* derivative at 129°.

***9. "The condensation of dimethyldihydroresorcin and of chloroketodimethyltetrahydrobenzene with primary amines. Part I. Monoamines, ammonia, aniline, and *p*-toluidine." By Paul Haas.**

Dimethyldihydroresorcin reacts with ketonic reagents as a diketone; in most of its other reactions, however, it behaves as a hydroxyketone having the formula $CMe_2\langle\begin{matrix}CH_2\cdot C(OH)\\CH_2\text{---}CO\end{matrix}\rangle CH$. In this form, it condenses with a single molecule of a primary amine by the elimination of water between the hydroxyl group and the amino-hydrogen, giving rise to a secondary amine. This replacement of the hydroxyl group by a basic group $-NHR$ caused the remaining ketonic oxygen to become hydroxylic, as shown by the fact that the new substance gives a colour reaction with ferric chloride and does not react with ketonic reagents; when, however, the basic substituting group is rendered more acid by acetylation, the resulting compound no longer gives any coloration with ferric chloride and condenses with semicarbazide, showing that the oxygen atom has become ketonic.

Chloroketodimethyltetrahydrobenzene, unlike dimethyldihydroresorcin, reacts at once with two molecules of a primary amine, giving rise to the hydrochloride of a mixed secondary and tertiary base having the formula $CMe_2\langle\begin{matrix}CH_2\cdot C(NHR)\\CH_2\text{---}C(:NR)\end{matrix}\rangle CH$. Bases of this type may also be prepared by condensing the mono-substituted derivatives, obtained by the action of dimethyldihydroresorcin on the amine, with a second molecule of the same amine in the presence of zinc chloride.

10. "Silicon researches. Part X. Silicon thiocyanate." By J. Emerson Reynolds.

The author found that silicon thiocyanate, $Si(SCN)_4$, is best prepared by prolonged digestion of pure lead thiocyanate in a benzene solution of silicon tetrachloride. An excess of the lead salt must be used, as the latter exchanges but one of its two thiocyanogen groups for chlorine, forming the yellow, crystalline compound $PbCl(SCN)$, silicon thiocyanate remaining in solution. The latter compound is obtained in fine white crystals, when most of the benzene is removed by distillation; but if any moisture is present the crystals become yellow owing to decomposition. This method of preparing the thiocyanate

gives a much better product than Miquel's (*Ann. Chim. Phys.*, 1877, [v], **11**, 343), in which the materials are heated to about 400°, as in this investigator's process charring results, and an impure substance is obtained.

The pure thiocyanate melts at 143·8° (corr.) and boils at 314·2° (corr.), distilling without decomposition.

The chief interest attaches to the constitution of the compound, as the somewhat analogous phosphorus "trithiocyanate" has been shown by A. E. Dixon (*Trans.*, 1901, **79**, 541) to exhibit "a form of tautomerism," in some cases acting as $P(NCS)_3$ and in others as $P(SCN)_3$.

The author has compared silicon thiocyanate with the phenylamide, $Si(NH{\cdot}C_6H_5)_4$, described in Part V of this series of papers, and has examined several interactions of the thiocyanate with aniline and other substances, and concludes from the results that it is correctly represented by the expression $Si(SCN)_4$.

11. "Halogen derivatives of substituted oxamides."
By Frederick Daniel Chattaway and William Henry Lewis.

The action of the halogens on substituted oxamides has been little studied, and the description given of the substances formed is not very satisfactory, as the crude products obtained were not subjected to any process of purification. The action of chlorine on oxanilide has been studied and a number of substituted oxanilides has been prepared in a simpler way in order to compare them with the foregoing products

The usual product of the chlorination of oxanilide is a mixture of *s*-di-*p*-chlorophenyloxamide and of its *s*-dichloroamino-derivative.

When aniline or a substituted aniline is heated with ethyl oxalate, a symmetrical disubstituted oxamide on the ethyl ester of a substituted oxamic acid is formed according as the aniline or the ethyl oxalate is in excess.

The symmetrical chlorophenyloxamides, which are almost insoluble in ordinary solvents, crystallise well from nitrobenzene, in which on heating they readily dissolve.

The following compounds were described: *s-di*-p-*chlorophenyloxodichloroamide*, colourless rhombs (m. p. 169°); *ethyl* p-*chlorophenyloxamate*, colourless plates (m. p. 155°); p-*chlorophenyloxamide*, colourless needles (m. p. 241°); *s-di*-p-*chlorophenyloxamide*, colourless, thin plates (m. p. 288°); *ethyl* 2 : 4-*dichlorophenyloxamate*, colourless, hair-like prisms (m. p. 119°); 2 : 4-*dichlorophenyloxamide*, colourless, hair-like crystals (m. p. 234°); *s-di*-2 : 4-*dichlorophenyloxamide*, colourless, slender prisms (m. p. 276°); *s-dimethyloxodichloroamide*, colourless, slender prisms (m. p. 37°); *s-diethyloxodichloroamide*, pale yellow, viscid

liquid which decomposes on heating; *s-dimethyloxodibromoamide*, pale yellow, flattened prisms (m. p. 95°); *s-diethyloxodibromoamide*, pale yellow plates (m. p. 82°).

12. "Menthyl benzenesulphonate and menthyl naphthalene-β-sulphonate." By Thomas Stewart Patterson and John Frew.

Menthyl benzenesulphonate and menthyl naphthalene-β-sulphonate have been prepared by the pyridine method. The former crystallises from alcohol in silky needles melting at 80°, the latter separates from alcohol in solid, opaque crystals melting at 114—114·5°. The compounds themselves decompose on continued heating at or above the melting point, so that their rotations have been determined in ethyl alcohol, benzene, and nitrobenzene. The chief points of interest are as follows: (1) there is considerable variation of rotation with change of solvent. (2) The values of $[M]_D$ for the β-naphthalene compound are consistently lower than for the benzenesulphonate in a given solvent. (3) The solvents, however, do not exert proportionate influences on the rotations of the two compounds. (4) Menthyl benzenesulphonate has a lower molecular rotation than menthyl benzoate by about 56°, and menthyl naphthalene-β-sulphonate a lower rotation than menthyl β-naphthoate by about 113°. (5) As regards the influence of temperature change on the rotations of these compounds in solution, it was found that the greater the rotation produced by a solvent the more rapid was its diminution with rise of temperature. The molecular rotations in dilute solution seem to tend at higher temperatures towards a common value of about −170°.

13. "Some reactions and new compounds of fluorine." By Edmund Brydges Rudhall Prideaux.

The fluorine was prepared by the electrolysis of anhydrous hydrogen fluoride contained in a copper vessel (Moissan, "Le Fluor et ses Composés"). In every case when the gas was analysed it was found to contain oxygen, and special experiments proved that this oxygen was produced at the anode even after the current had passed for a considerable time.

Liquid fluorine has no solvent or chemical action on iodine. The colourless iodine fluoride was analysed by a volumetric method, and four concordant percentages of iodine confirmed the formula IF_5 established by Moissan (*Compt. rend.*, 1902, **135**, 563) from the results of gravimetric analysis.

Bromine fluoride was prepared for the first time; analyses carried

out by a gravimetric method led to the formula BrF_3. Liquid fluorine has neither solvent nor chemical action on solid bromine.

Gaseous fluorides of selenium and tellurium were prepared by the direct combination of the elements in the cold. The formulæ of these gases were proved to be SeF_6 and TeF_6 by determinations of their densities. Analysis of TeF_6 also showed it to have this formula. These gases are colourless and easily condensable by moderate cold or pressure to white, crystalline solids and colourless liquids respectively. Tellurium hexafluoride has an unpleasant odour and decomposes water slowly at 15°; selenium hexafluoride does not decompose water at 15°.

The vapour pressure curve of SF_6 was determined for comparison with those of SeF_6 and TeF_6. The three curves resemble one another closely. In the case of SF_6 and SeF_6, the melting points lie above the temperatures at which the vapour over the solid attains a pressure of 760 mm., whilst in the case of TeF_6 the melting point lies just below the boiling point. The critical temperatures of the liquefied gases rise in the order SF_6, SeF_6, TeF_6.

The molecular volumes at temperatures equally removed from the melting points were found to be very nearly the same.

The refractivities of the three compound gases bear no simple additive relation to those of their constituent elements.

The refractivities *minus* a constant are directly proportional to the densities of the gases.

14. "Contributions to the chemistry of the rare earths. Part I." By Mario Esposito.

The methods advocated for the separation of cerium, lanthanum, and "old didymium" have been examined comparatively with the following results.

Preparation of the Material.—Rather more than half a kilogram of finely-powdered Swedish cerite was mixed into a paste with water, and 375 grams of concentrated sulphuric acid were gradually added. Considerable evolution of heat took place and the mass swelled up somewhat. The excess of acid was then removed by heat, and the cold white or grey mass was thrown in small portions into 5 litres of ice-cold water. The silica was removed by filtration and a current of hydrogen sulphide was passed through the solution to precipitate any arsenic, molybdenum, bismuth, copper, or lead which might be present. To the filtrate, oxalic acid was added, which precipitated all the ceria, lanthana, and "didymia" along with lime and traces of the yttrium group which are present in cerite (Brauner, *Trans.*, 1883, **43**, 278). The oxalates were thoroughly washed and dried.

Methods of Separation.—(1) The first method tried was that origin-

ally proposed by Watts (*Quart. Journ. Chem. Soc.*, 1850, **2**, 131). Some of the reddish-brown oxide prepared by igniting the foregoing oxalates was boiled for several hours with a strong ammonium chloride solution until no more dissolved. The reddish-brown, insoluble ceria was washed with ammonium chloride solution and dissolved by boiling with alcohol and strong hydrochloric acid. The solution showed strong "didymium" absorption bands, and probably also contained lanthanum.

(2) Brauner's basic nitrate method (*Trans.*, 1883, **43**, 278; 1885, **47**, 879) gave fairly good results, but some of the cerium remains in solution.

(3) Popp's method (*Annalen*, **1864**, **131**, 360), which consists either in boiling a neutral solution of the chlorides with sodium acetate and sodium hypochlorite or in passing a current of chlorine through a solution mixed with sodium acetate, gives good results on a small scale, but is inconvenient with larger quantities.

(4) Although the same objection applies to Mosander's method with caustic potash and chlorine (*Poggendorff's Ann.*, 1843, **60**, 297), very pure ceria can thus be obtained.

(5) For ordinary purposes, however, the process devised by H. Debray (*Compt. rend.*, 1883, **96**, 928), slightly modified as follows, seems to give rapid and satisfactory results. The dried oxalates were boiled with strong nitric acid until completely decomposed, the solution was evaporated to dryness, the last part of the process being conducted on a sand-bath, and the anhydrous nitrates mixed with twice their weight of sodium nitrate were fused in a porcelain dish until no more nitrous fumes were evolved. The cold mass was detached from the dish, coarsely powdered, and digested in warm water acidified with nitric acid. The insoluble, pale yellow ceric oxide was collected and washed with ammonium nitrate solution, as recommended by Schützenberger (*Compt. rend.*, 1895, **120**, 663). If pure water is used, the finely-divided ceric oxide will pass through the filter. The filtrate was again evaporated to dryness and fused so as to eliminate the remainder of the cerium. The lanthanum and "didymium" were subsequently separated by fractional crystallisation of the oxalates from strong nitric acid solution, as will be described in a future communication.

(6) Very pure ceria can be obtained by the following method, which depends on the use of chromic acid. The solution of nitrates was precipitated with caustic soda, and the hydroxides were washed several times by decantation with boiling water. A warm aqueous solution of chromic acid was then added and the whole left for several days. A heavy, yellowish-white precipitate remained, which, on ignition at a gentle heat, yielded cerium sesquioxide as an almost white powder

without the slightest tinge of red or yellow. When thus obtained, the oxide dissolved readily in boiling hydrochloric acid, and the solution, even when viewed through a considerable thickness, did not show a trace of absorption bands.

This last method will be further studied. A chromic-acid method was formerly devised by Pattinson and Clarke (*Chem. News*, 1867, **16**, 259), but the process is entirely different from the foregoing, and has the disadvantage of giving a ceric oxide which is absolutely insoluble in acids.

15. "A synthesis of aldehydes by Grignard's reaction." By Gordon Wickham Monier-Williams.

Gattermann and Maffezzoli (*Ber.*, 1903, **36**, 4152) showed that aldehydes could be obtained by the action of organo-magnesium compounds on ethyl formate $H{\cdot}CO{\cdot}O{\cdot}C_2H_5 + IMgX = C_2H_5{\cdot}O{\cdot}MgI + X{\cdot}CHO$, and various other investigators have carried out analogous syntheses with derivatives of ethyl formate, for example, bromoform, iodoform, ethyl orthoformate, disubstituted formamides, and *iso*nitriles. The author has shown that ethoxymethyleneaniline,

$$C_6H_5{\cdot}N{:}CH{\cdot}O{\cdot}C_2H_5,$$

reacts readily with organo-magnesium compounds to give the anhydro-compound of aniline with the aldehyde in question, from which the latter is easily obtained. The yields are in many cases far better than those given by the older methods. Ethoxymethyleneaniline was prepared by the action of ethyl iodide on the silver derivative of formanilide, $C_6H_5N{:}CH{\cdot}OAg$ (Comstock and Kleeberg, *Amer. Chem. J.*, 1890, **12**, 497), and was allowed to react in absolute ethereal solution at 35° on organo-magnesium compounds. Benzaldehyde, *o*-tolualdehyde, *α*- and *β*-naphthaldehydes were obtained from the respective bromo-compounds with yields of 46, 54, 48, and 36 per cent. respectively. Some derivatives of *β*-naphthaldehyde were prepared and analysed, notably *β*-naphthylacrylic acid,

$$C_{10}H_7{\cdot}CH{:}CH{\cdot}CO_2H,$$

and dinitro-*β*-naphthaldehyde, $C_{10}H_5(NO_2)_2{\cdot}CHO$. The method was then applied to the synthesis of a new aldehyde, *p*-thiophenetylaldehyde, $C_2H_5S{\cdot}C_6H_4{\cdot}CHO$. *p*-Nitrothiophenetole (Blanksma, *Rec. trav. chim.*, 1901, **20**, 403) on reduction gave *p*-thiophenetidine,

$$C_2H_5S{\cdot}C_6H_4{\cdot}NH_2,$$

a slightly yellow liquid boiling at 280°. Its acetyl derivative is thiophenacetine, which, however, does not exert the physiological action of phenacetine. The base was successively converted into the iodo-compound, $C_2H_5S{\cdot}C_6H_4I$, a slightly yellow oil boiling at 146°/11 mm., and the aldehyde, $C_2H_5{\cdot}S{\cdot}C_6H_4{\cdot}CHO$, boiling at 245°. Several

derivatives of the latter were prepared, of which the azine is very characteristic. The oxidation of the aldehyde with alkaline permanganate gave rise to a sulphonecarboxylic acid, $C_2H_5 \cdot SO_2 \cdot C_6H_4 \cdot CO_2H$.

16. **"The action of ultra-violet light on moist and dry carbon dioxide." By Samuel Chadwick, John Edwin Ramsbottom, and David Leonard Chapman.**

By the action of ultra-violet light on dry carbon dioxide, the authors have succeeded in partially decomposing carbon dioxide into carbon monoxide and oxygen. The circumstances of the experiment rendered it impossible to decide what percentage of the oxygen was present in the form of ozone. If the carbon dioxide is moist there is no decomposition. The peculiar influence of water vapour is believed to be due to the action which it exerts on the vibrations of the electrons of the atoms of which the molecules of carbon monoxide, carbon dioxide, and oxygen are composed. The facts, discovered by Chapman and Burgess, concerning the induction period of a mixture of chlorine and hydrogen are regarded as confirming this view.

17. **"A contribution to the study of stable diazo-compounds. Preliminary note." By Gilbert Thomas Morgan and William Ord Wootton.**

p-Aminobenzanilide, which has been shown to give on diazotisation a stable diazo-carbonate and a corresponding nitrite (*Trans.*, 1905, **87**, 938), also furnishes a diazonium picrate,

$$C_6H_5 \cdot CO \cdot NH \cdot C_6H_4 \cdot N_2 \cdot O \cdot C_6H_2(NO_2)_3,$$

which is precipitated even in the presence of hydrochloric acid. This substance, which is insoluble in water and crystallises from warm alcohol in rosettes of yellow needles decomposing at 132°, does not explode on percussion. When dissolved in aqueous caustic soda and added to alkaline β-naphthol, it yields a precipitate of benzoyl-*p*-aminobenzene-azo-β-naphthol. Mercury acetamide has been found to yield sparingly soluble, stable additive compounds when added to the aqueous solution of a diazonium salt, and a series of these substances is under investigation. The compound with benzenediazonium chloride gave, on analysis, N = 12·46, whereas $C_6H_5 \cdot N_2Cl, Hg(NH \cdot CO \cdot CH_3)_2$ requires N = 12·26 per cent. Similar stable mercury acetamide derivatives have been obtained from the substituted anilines and their homologues.

18. "Triarylsulphonium bases." By Samuel Smiles and Robert Le Rossignol.

Quite recently Kehrmann and Duttenhöfer have published a paper (*Ber.*, 1905, **38**, 4197) dealing with mono- and di-arylsulphonium bases, and, although their work does not clash with that of these investigators, the authors considered it desirable to communicate the following preliminary note to the Society.

It has been found that triarylsulphonium bases can be prepared in three ways.

(1) By the action of thionyl chloride on a phenol or phenolic ether in presence of aluminium chloride.

(2) By the action of a sulphinic acid on a phenolic ether in presence of concentrated sulphuric acid.

(3) By the condensation of an aromatic sulphoxide with phenols or their ethers.

It can be shown that sulphoxides are formed during the first and second reactions, and hence the third reaction may be regarded as the final stage of the first two. The condensation between sulphoxide and phenol takes place with acid condensing agents, and it is the authors' view that the sulphoxide, being basic in character, first forms a salt $Ar_2S(SO_4H)\cdot OH$, which then reacts with the phenol, losing hydroxyl and forming the sulphonium salt, thus:

$$Ar_2S(SO_4H)\cdot OH + C_6H_5\cdot OH = Ar_2S\cdot C_6H_4(OH)\cdot SO_4H + H_2O.$$

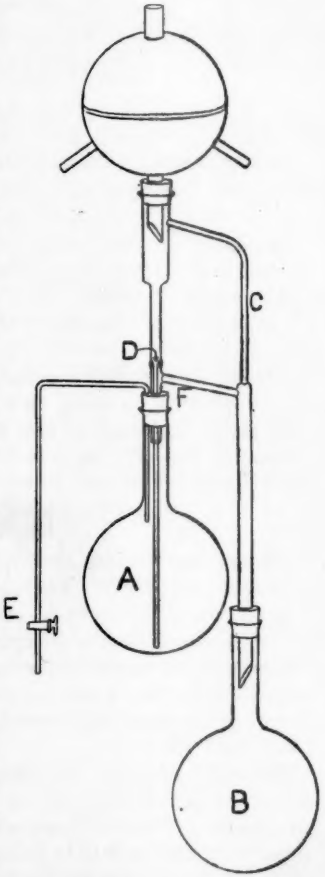
This reaction seems to be reversible and a slight excess of phenol must be present to render the conversion of sulphoxide to sulphonium salt complete. At present only the hydroxy- and ethoxy-derivatives have been examined, but the authors hope to extend the investigation to amide and other compounds.

19. "An improved apparatus for the continuous extraction of liquids with ether." By Richard Sisson Bowman.

The apparatus here described differs essentially from those due to Hagemann (*Ber.*, 1893, **26**, 1975), Pellizza (*Chem. Centr.*, 1904, **1**, 851), and Mameli (*loc. cit.*, 1905, **2**, 106). In the latter, hot ether vapour is blown through the liquid to be extracted, whilst in the former the extraction is effected by passing cool liquid ether through the solution. Violent bubbling is thus avoided, together with the consequent risk of carrying over mechanically into the ether flask some of the liquid to be extracted.

The apparatus comprises a simple system of tubes, a condenser, and two ordinary flasks, preferably round bottomed.

The liquid to be extracted is placed in the flask *A* in sufficient quantity to very nearly fill the flask to the bottom of the neck. This flask may frequently be replaced with advantage by a wide test-tube. From one-eighth to one-fifth of this volume of ether, with which the substance is to be extracted, is placed in the flask *B*, which is heated on a water-bath or electric heater. The ether passing as vapour up tube *C* is condensed in the condenser and falls back and collects in the inner tube, *D*. A column presently accumulates in *D* long enough to force its way through the liquid in *A*, and there is then a constant succession of small drops of ether ascending in *A*, collecting on the surface of the liquid, and finally overflowing at *F* and returning to the flask *B*.



On completion of the process of extraction, the neck of the flask will be filled with ether. There will also be a column of ether in tube *D*, reaching a few centimetres above tube *F*, and hence the neck of the flask may be emptied by opening the stopcock *E* and allowing the ether to run off into some vessel. If necessary, the flask may now be replaced by a similar one containing a fresh portion of the liquid to be extracted and the process resumed.

Among other advantages claimed for this apparatus are that whereas the other forms involve either expert glass blowing or innumerable cork and india-rubber joints, it is simple in construction and may easily be made by anyone moderately skilled in the use of the blowpipe. It is very easy to keep clean and convenient to charge, since the vessels which contain the liquid to be extracted and the extracting liquid are ordinary flasks. A large quantity of liquid, moreover, may be rapidly and completely extracted with the use of a very small quantity of ether.

Benzene, ligroin, or any other suitable solvent may be used with equal ease, provided it is immiscible with water and of lower specific gravity than the liquid which it is to be used to extract.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Aschan, *Ossian.* Chemie der alicyklischen Verbindungen. pp. xlv + 1163. Braunschweig 1905. (*Recd.* 7/12/05.)
From the Publishers.

Carnegie, *Douglas.* Law and theory in chemistry. pp. 222. London 1894. (*Recd.* 21/12/05.) From Professor R. Meldola.

Richmond, *H. Droop.* The laboratory book of dairy analysis. pp. viii + 90. ill. London 1905. (*Recd.* 20/11/05.)
From the Author.

Thresh, *John C.* The examination of waters and water supplies. pp. xvi + 460. ill. London 1904. (*Recd.* 18/12/05.) From the Author.

Walker, *A. Jamieson,* and **Mott,** *Owen E.* An introduction to volumetric analysis. pp. x + 64. London 1905. (*Recd.* 20/12/05.)
From the Publishers.

II. *By Purchase.*

Abney, *Sir William de Wiveleslie.* Instruction in photography. 11th edition. pp. 676. ill. London 1905. (*Recd.* 18/12/05.)

Borel, *Pierre.* Bibliotheca chimica seu catalogus librorum philosophicorum hermeticorum in quo quatuor millia circiter, authorum chimicorum, vel de transmutatione metallorum, re minerali, et arcanis, tam manuscriptorum, quam in lucem editorum, cum eorum editionibus, usque ad annum 1653 continentur. pp. xii + 276. Paris 1654. (*Recd.* 19/12/05.)

Boyle, *Hon. Robert.* New experiments and observations touching cold, or an experimental history of cold, begun. To which are added an examen of antiperistasis, and an examen of Mr. Hobs's doctrine about cold. Whereunto is annexed an account of freezing, brought in to the Royal Society, by the learned Dr. C. Merret, a Fellow of it. pp. lviii + 845 + 54. ill. London 1665. (*Recd.* 18/11/05.)

Chemisch-technische Untersuchungsmethoden. Edited by *Georg* **Lunge.** Vol. III. pp. xxvii + 1305 + xliv. ill. Berlin 1905. (*Recd.* 18/12/05.)

Church, *Arthur Herbert.* Precious stones considered in their

scientific and artistic relations. pp. x + 135. ill. London 1905. (*Recd.* 28/12/05.)

Doelter, *C.* Physikalisch-chemische Mineralogie. pp. xi + 272. ill. Leipzig 1905. (*Recd.* 21/12/05.)

Eder, *Josef Maria.* Geschichte der Photographie. pp. xvi + 484. ill. Halle a. S. 1905. (*Recd.* 18/12/05.)

Heddle, *M. Forster.* The mineralogy of Scotland. Edited by *J. G.* **Goodchild.** 2 vols. pp. lviii + 148, viii + 247. ill. Edinburgh 1901. (*Recd.* 20/12/05.)

Kayser, *Edmond.* Microbiologie agricole. pp. xii + 440. ill. Paris [1905]. (*Recd.* 20/12/05.)

At the next Ordinary Meeting, on **Thursday,** February **1st,** 1906, at **8.30** p.m., the following papers will be communicated:

"Hydroxylamine-$\alpha\beta$-disulphonates (structural isomerides of hydroximinosulphates or hydroxylamine-$\beta\beta$-disulphonates)." By Tamemasa Haga.

"Studies in the camphane series. Part XXI. Benzenediazo-ψ-semicarbazinocamphor and its derivatives." By M. O. Forster.

"The relation between absorption spectra and chemical constitution. Part I. The chemical reactivity of the carbonyl group." By A. W. Stewart and E. C. C. Baly.

"The relation between absorption spectra and chemical constitution. Part II. The quinones and α-diketones." By E. C. C. Baly and A. W. Stewart.

"The relation between absorption spectra and chemical constitution. Part III. The nitranilines and the nitrophenols." By E. C. C. Baly and A. W. Stewart.

"The action of light on benzylidenephenylhydrazine." By F. D. Chattaway.

"The union of chlorine and hydrogen." By D. L. Chapman and C. H. Burgess.

"Note on the molecular weight of adrenaline." By G. Barger and A. J. Ewins.

"The critical temperature and value of $\frac{ML}{\Theta}$ of some carbon compounds." By J. Campbell Brown.

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Issued 9/2/06

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 304.

Thursday, February 1st, 1906, at 8.30 p.m. Professor R. MELDOLA, F.R.S., President, in the Chair.

Mr. J. B. Tillott was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs. :

Roderick Harold Capper Birt, B.A., 54, Shooter's Hill Road, Blackheath, S.E.
William Dickson, Bra some, Bridge of Weir.
James Stuart Hills, 2_ , Oxford Street, W.
Ernest Ormerod, M.Sc., Ph.D., 8, Leopold Road, Wimbledon, S.W.
John Henry West, 11, Sydney Street, Chelsea, S.W.
Henry John Wiffen, 17, Albany R ad, Manor Park, E.

Of the following papers, those marked * were read :

***20. "Hydroxylamine-$\alpha\beta$-disulphonates (structural isomerides of hydroximinosulphates or hydroxylamine-$\beta\beta$-disulphonates)." By Tamemasa Haga.**

In a previous paper (*Trans.*, 1904, **85**, 78 ; Proc., 1903, **19**, 281), it was shown that Fremy's *m-tasulphazilates* are *hydroxylaminetrisulphonates*. From these salts there has now been obtained by hydrolysis a new series of salts which are structurally isomeric with Fremy's *neutral* and *basic sulphazotates*, now known to be *hydroxylaminedisulphonates*. The new salts are decomposed by sodium

amalgam, and are proved by the nature of this change, by their decomposition by concentrated potassium hydroxide solution, and by their hydrolysis, to be *hydroxylamine-αβ-disulphonates*, in contrast with the *sulphazotates*, which are *hydroxylamine-ββ-disulphonates*, $SO_3K{\cdot}ONH{\cdot}SO_3K$ and $HON(SO_3K)_2$, respectively. This is believed to be the first indisputable case of the occurrence of fundamental structural isomerism among inorganic compounds. Sodium converts the new salts into sulphate and aminemonosulphonate; potassium hydroxide into the same products, together with nitrogen; and acids transform them into sulphate and hydroxylamine. The new salts are practically all soluble in water and fairly stable; those prepared are principally the di- and tri-potassium salts, di- and tri-sodium salts, and the di-ammonium salt. A *hydroxylamine-α-monosulphonate* seems incapable of existence; it would be, for example, a sulphate of potassium and amidogenium, $H_2NO{\cdot}SO_2{\cdot}OK$.

Discussion.

Dr. Divers said that it follows somewhat unexpectedly from the author's results that it is the presence of oxylic hydrogen and not aminic hydrogen in a hydroxylamine derivative or in hydroxylamine itself which makes it easily oxidisable. For, whilst a hydroxylamine-αβ-disulphonate is not sensitive to oxidising agents, although it contains an atom of aminic hydrogen, a hydroxylamine-ββ-disulphonate which contains none is readily oxidised to a peroxylaminesulphonate (*Trans.*, 1904, **85**, 78; Proc., 1903, **19**, 281) by virtue of the oxylic hydrogen atom, which is present in it but not in the αβ-salt. Applying this deduction from facts to the case of the very sensitive hydroxylaminemonosulphonates, an explanation is found for the fact that these salts, when oxidised, as by cupric chloride or by cupric oxide in alkaline solution (*Trans.*, 1889, **55**, 760), give nitrous oxide but no hyponitrite, although when decomposed by potassium hydroxide alone they give much hyponitrite, together with sulphite. The production of hyponitrite by alkali alone is represented by

$$2(SO_3K)HNOH + 4KHO = 2(SO_3K)KNOK + 4H_2O = 2SO_3K_2 + (NOK)_2 + 4H_2O.$$

Its non-production, when cupric oxide is also present, is accounted for by the equation:

$$O + \begin{matrix} H{\cdot}O \\ | \\ H{\cdot}N{\cdot}(SO_3K) \end{matrix} + \begin{matrix} N(SO_3K)K \\ | \\ OK \end{matrix} = OH_2 + N_2O + SO_4K_2 + SO_3K_2.*$$

* Copper sulphate induces oxidation of a hydroxylaminemonosulphonate catalytically, causing one-half of it to be reduced to aminemonosulphonate in oxidising the other half in the way just formulated (compare *Trans*, 1900, **77**, 978).

It should therefore be taken into consideration, when determining the constitution of organic and other substitution derivatives of hydroxylamine, that indifference to oxidising agents is not evidence of the absence of aminic but of oxylic hydrogen.

He also suggested, in explanation of the fact that a small part of a hydroxylamine-$\alpha\beta$-disulphonate is much more difficult to hydrolyse than the rest, that the salt may polymerise to some extent during the heating and thus become resistant to hydrolysis.

In reference to the circumstance that some of the author's results had been anticipated by Raschig (*Ber.*, 1906, **39**, 245), and the question of dating communications having been raised by Professor McLeod, Professor ARMSTRONG expressed the hope that no alteration in the existing practice would be made, and that nothing would be done to deprive authors of the liberty which they had so long enjoyed of correcting their papers up to the moment of publication. It was most undesirable that anything should be done to encourage discussions as to priority among authors. The public were gainers when, as in the present case, independent workers arrived at similar results.

***21. "Studies in the camphane series. Part XXI. Benzenediazo-ψ-semicarbazinocamphor and its derivatives." By Martin Onslow Forster.**

When a diazonium salt is added to an aqueous solution of camphoryl-ψ-semicarbazide nitrate, the corresponding derivative of *benzenediazo-ψ-semicarbazinocamphor*, $C_8H_{14}\begin{cases}CH\text{———}N\cdot NH\cdot N{:}N\cdot C_6H_5\\ C(OH)\cdot NH\cdot CO\end{cases}$, is precipitated. Compounds of this class may be called diazo-ψ-semicarbazines, and have been obtained from diazotised aniline, *p*-toluidine, *p*-anisidine, *p*-chloroaniline, *p*-bromoaniline, and the three nitroanilines; they are characterised by the readiness with which dilute alkalis resolve them into camphoryl-ψ-carbamide and the corresponding phenylazoimide. The author dissented from the views on coloured camphor derivatives expressed by Armstrong and Robertson (*Trans.*, 1905, **87**, 1272).

DISCUSSION.

In replying to Dr. Forster, Prof. ARMSTRONG said that, beyond remarking that Stobbe's results were in no way irreconcilable with his (the speaker's) views as to the origin of colour, as he proposed to consider them on another occasion, he should not deal with them then; nor would he continue the discussion on the relation of optical activity to structure in hydrazones, as this subject could not be dealt

with properly in the time at disposal. He would confine his remarks to the compounds described by Dr. Forster. Of the two alternative formulæ available for the semicarbazines, Dr. Forster had selected that containing the group ·N·NH·N:NPh. Inasmuch as compounds containing the group ·N:NPh were at least *yellow*, he was of opinion that the formula selected did not represent the *colourless* compounds. He was of opinion also that, although prepared by one method, Dr. Forster's compounds were not all of one type, any more than *o*- and *p*-nitrophenol and nitraniline were compounds of the same type as the corresponding bromophenols and bromanilines. It had long been admitted that the nitro-compounds referred to are at least partially composed of the isodynamic quinonoid forms; the differences observed by Dr. Forster between his colourless and coloured compounds were precisely those observed on comparing the bromanilines with the nitranilines.

Dr. Lander remarked that it was unlikely that nitrogen compounds of this type would exhibit tautomerism. Pechmann had shown that the so-called "virtually tautomeric" mixed amidines were mixtures or "solid solutions" of structural isomerides, and further that the isomerism disappeared when the hydrocarbon residues were of different types, as in Dr. Forster's compounds.

Dr. Lowry said that Dr. Forster appeared to have overlooked the fact that one of Stobbe's compounds, the phenyldimethylfulgide (*Ber.*, 1905, **38**, 3895) existed both in a yellow and in a colourless form, the two forms being convertible into one another in much the same way as the isomeric white and yellow oximes of the mesoxamide series studied by Dr. Whiteley (*Trans.*, 1903, **83**, 24). There was, therefore, the clearest possible evidence of the existence of dynamic isomerism in Stobbe's series of compounds, and the argument that individual members of such a series must have the same constitution because prepared in the same way and exhibiting similar chemical properties was entirely fallacious.

Dr. Morgan cited the case of the ortho-diazoimines as another example of a group of compounds the members of which series differed considerably in colour although they were all prepared by the same general method and had similar properties. Diazoiminobenzene and its acyl derivatives were white or colourless substances. 2 : 3-Diazoiminonaphthalene was described as yellow, whereas 1 : 8-diazoiminonaphthalene is brownish-red. In spite of this colour difference there seemed to be no reason for supposing that these substances were differently constituted.

Although three of Dr. Forster's diazo-ψ-semicarbazines were nitro-compounds and possibly owed their colour to the presence of the nitro-group, yet it was very unlikely that the yellow *p*-anisyl derivative

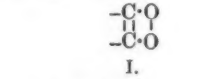
should be differently constituted to the white *p*-tolyl compound, inasmuch as the former differed from the latter only in the substitution of methoxyl for methyl in the para-position to the diazo-complex.

Dr. FORSTER, in reply, regretted that Dr. Lowry had misunderstood his attitude. He had not used "the argument that individual members of such a series must have the same constitution because prepared in the same way and exhibiting similar chemical properties." His contention was, that in the absence of chemical distinctions among a series of compounds prepared alike, it was unsafe to say that the structural type of a colourless compound must differ from that of a coloured one merely because the substances differed in appearance. That was his reason for criticising the views of Professor Armstrong and Mr. Robertson regarding the structure of their camphorquinone-hydrazones, and nothing had been said that evening which impaired his conviction that to deduce a certain constitutional formula for a coloured substance solely from the assumption that the colour is due to the constitution ascribed is arguing in a circle, and therefore unacceptable.

***22. "The relations between absorption spectra and chemical constitution. Part I. The chemical reactivity of the carbonyl group." By Alfred Walter Stewart and Edward Charles Cyril Baly.**

Attention has been drawn (*Trans.*, 1904, **85**, 1029, and 1905, **87**, 766) to the relation which exists between tautomerism and the selective absorption which is shown by the spectra of derivatives of ethyl acetoacetate, whilst it has also been proved that the rates of addition of sodium hydrogen sulphite to ketones can be influenced by the introduction of a carboxyl radicle into the molecule, and that the effect thus produced is directly opposite to what one would expect if the hypothesis of steric hindrance held good (*Trans.*, 1905, **87**, 185, and *Proc.*, 1905, **21**, 78). In the present paper, it is shown that these two phenomena are connected with one another, and the relation is indicated between the activity of the carbonyl group in certain ketones and their selective absorption. It is pointed out that in certain cases the phenomena of tautomerism furnish an explanation of the exceptional reactivity of the carbonyl group, as the passage from the enolic to the ketonic form would give rise to a carbonyl radicle, the condition of which may be considered as approximating to that of a nascent atom. This "nascent carbonyl group" would be more reactive than the normal carbonyl. But although in most instances tautomerism suffices to explain the phenomena, it breaks down in several cases, and to cover these a new and wider conception is re-

quired. From spectroscopic evidence it appears that in the α-diketones a vibration is going on which to a certain extent resembles that which was found in the case of ethyl acetoacetate and its derivatives. The nature of this vibration cannot be easily expressed in the ordinary structural formulæ without the possibility of misconception, but it may be indicated somewhat as follows. The vibration is brought about by some change in the relations between the carbon and oxygen atoms, and it in some respects resembles the transition from the ketonic to the enolic form and back again. Using this analogy, we may postulate that the two extreme phases of the vibration can be re-represented by the formulæ:



I. II.

The conversion of I into II would give rise to the "nascent carbonyl group," just as the change of the enolic into the ketonic form does. Further, the experimental evidence available shows that some such relation does actually exist between the carbonyl groups of benzoquinone, and the great reactivity of the quinones can be thus explained. It is proposed to term the general phenomenon "*isorropesis*" and to call "*isorropic*" those radicles the activity of which is thus produced.

***23. "The relation between absorption spectra and chemical constitution. Part II. The quinones and α-diketones." By Edward Charles Cyril Baly and Alfred Walter Stewart.**

In the preceding communication, it was shown that in the absorption spectrum of ethyl pyruvate an absorption band is developed in a different region and at a different dilution from the bands given by the substances having a labile hydrogen atom (Baly and Desch, Trans., 1904, **85**, 1029; 1905, **87**, 766). This band was shown to be due to the two carbonyl groups in juxtaposition to one another; when two such carbonyl groups are present in the molecule, a new type of oscillation is induced, resulting in the absorption of light of a much longer wave-length than is absorbed by the process of enol-keto-tautomerism. For this new type of oscillation, the name isorropesis was proposed. In the present paper it was shown that this isorropesis in α-diketones results in the absorption of light in the visible blue region, so that the substances are intensely yellow. This is evidenced by camphorquinone and diacetyl. An analogous condition in the close proximity of the carbonyl groups occurs in benzoquinone. It is shown that quinone develops the same absorption

band as do diacetyl and camphorquinone. The process of isorropesis occurs therefore in benzoquinone exactly as in the case of the α-diketones and is the origin of the yellow colour of this substance. The same is found to be true in the case of *p*-xyloquinone, toluquinone, α-naphthaquinone, acenaphthenequinone, and phenanthraquinone. There is little doubt, therefore, that the yellow colour of the quinones is due to the isorropesis between the carbonyl groups in juxtaposition. These observations strongly support Armstrong's theory that the colour of certain benzene derivatives is due to the quinonoid linking, for they show that the colour is caused, not directly by this linking, but by the isorropesis between the unsaturated atoms where this linking exists.

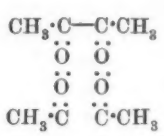
***24. "The relation between absorption spectra and chemical constitution. Part III. The nitranilines and the nitrophenols." By Edward Charles Cyril Baly, Walter Henry Edwards, and Alfred Walter Stewart.**

In this paper are described the absorption spectra of compounds having the quinonoid linking and containing a nitrogen atom in place of one or both of the quinone oxygen atoms. By a comparison of the absorption spectra of the nitranilines with those of their hydrochlorides, it is shown that the free substances must exist in the quinonoid form, and that, as they show the same absorption band as benzoquinone and the α-diketones, a similar process of isorropesis takes place between the unsaturated nitrogen atoms as between the oxygen atoms of benzoquinone and the α-diketones. Similar arguments are found to hold good for the nitrophenols and for nitrosophenol. By these observations the principle developed in the preceding papers that the colour of the quinones is due to the oscillation or isorropesis between the oxygen atoms is extended to those quinonoid compounds containing nitrogen atoms in the place of one or both of the oxygen atoms.

DISCUSSION.

Prof. ARMSTRONG said that Mr. Baly had put aside entirely the view which had long been held that ketonic interactions were conditioned by the combination of various substances with the carbonyl group and had adopted an entirely *intra*-molecular view of change, whether chemical or physical. He, however, was inclined to advocate the view that the changes were *inter*-molecular. He also still adhered to the opinion that three absorbing centres were required to produce visible colour, *i.e.*, that iodoform, not methylene iodide, might be taken as typical of coloured substances. From this point

of view, the colour of compounds such as diacetyl might be accounted for on the assumption that polymeric molecules were present, formed by the association, through the residual affinity of the oxygen atoms, of the ketonic groups, *e.g.* :



This explanation might perhaps apply also to metanitrophenol and metanitraniline. He remarked subsequently that the blue colour of water might be accounted for from this point of view but not by Mr. Baly's hypothesis.

In reply to Prof. Armstrong, Mr. BALY pointed out that the absorption spectrum of acetone and ethyl acetoacetate in aqueous solution shows that the tautomeric process is much decreased by the action of the solvent. Similarly, in the case of benzoquinone, the absorption band due to isorropesis exhibited in alcoholic solution entirely disappears when the substance is examined in aqueous solution, its place being taken by two bands in the ultra-violet region. These facts, due no doubt to the formation of hydrates, are strong evidence against the suggestion made by Prof. Armstrong that the colour of diacetyl is due to a complex of two molecules of this substance.

*25. "The action of light on benzaldehydephenylhydrazone." By Frederick Daniel Chattaway.

Fischer, who first prepared the ordinary stable α-modification of benzaldehydephenylhydrazone (*Annalen*, 1878, **190**, 135), noted that it reddened when exposed to the air, and this observation was confirmed by Biltz (*Zeit. physikal. Chem.*, 1899, **30**, 527), and Reutt and Pawlewski (*Bull. Acad. Sci. Cracow*, 1903, 503), who added that the reddening takes place on exposure to light, and disappears when the compound is heated or placed in the dark. The author has extended these observations, and shows that the presence or absence of air does not affect the coloration which is brought about by the violet and blue portions of the spectrum only. The changes of colour are probably due to a reversible isomeric change from the hydrazino- to the azo-configuration,

$$C_6H_5\cdot CH{:}N\cdot NH\cdot C_6H_5 \qquad C_6H_5\cdot CH_2\cdot N{:}N\cdot C_6H_5.$$

The colour produced in benzaldehydephenylhydrazone when it has reached its maximum exactly equals in shade and intensity that of azobenzene itself. This explanation of the colour change is supported by the behaviour of benzaldehydediphenylhydrazone and benzaldehydebenzylphenylhydrazone, which are not capable of undergoing this type of change, and which are not altered in colour by light.

This intramolecular rearrangement caused by light and accompanied by colour change leads to the suggestion that the fading of organic colouring matters in sunlight may in some cases at least be due to a similar reversible isomeric change.

Discussion.

Dr. Wade, who asked whether the author had noticed the production of the coloured modification of the hydrazone at the moment of its formation, more especially in benzene solution, stated that he had experienced great difficulty in obtaining a colourless product when the reacting substances were dissolved in this solvent.

Mr. W. Robertson pointed out that according to the Hantzsch-Werner hypothesis two stereoisomerides are possible; in the case, however, of the benzaldehydephenylhydrazones, three isomeric modifications are known and it is highly probable that all three possess different constitutions. The significance of the colour of the substituted benzaldehydephenylhydrazones when taken in conjunction with the red unstable "benzylidenephenylhydrazine" was explained and the opinion expressed that the nitrobenzaldehydephenylhydrazones were, in reality, stable azo-compounds.

26. "The union of chlorine and hydrogen." By Charles Hutchens Burgess and David Leonard Chapman.

The authors have investigated the dependence of the character of the induction period on the conditions. The results obtained increased the difficulty of explaining the phenomenon in question by the theory of an intermediate compound. They also indicated that the effect must be due to some retarding impurity. The impurity was found to be a gaseous compound resulting from the interaction of chlorine and ammonia. An inhibitive compound can also be formed by the action of chlorine on compounds capable of yielding ammonia on oxidation. When such substances are present in the actinometer, the retarding impurity can be gradually formed for considerable periods of time, so that the mixture after it has been previously induced can again become inert when it is allowed to remain in the dark. If the gases and the

water contained in the actinometer are carefully purified from all ammoniacal impurity, no induction period can be observed even after the actinometer has stood for weeks in the dark.

Ammonia (chlorine-substituted ammonia) retards the action between chlorine and formaldehyde in the light. Its inhibitive effect is, however, much less in this case.

No difference could be detected in the absorption coefficients of mixtures in equal volumes of air and chlorine and of hydrogen and chlorine. The energy which brings about the combination of hydrogen and chlorine is therefore probably derived from the light absorbed by the chlorine in virtue of its optical properties.

27. "Note on the molecular weight of epinephrine." By George Barger and Arthur James Ewins.

Abel and Taveau have recently (*J. Biol. Chem.*, 1905, **1**, 1) objected to the formula $C_9H_{13}O_3N = 183$ for epinephrine (adrenaline), the active principle of the adrenal gland. They prefer the formula $2(C_{10}H_{13}O_3N,\frac{1}{2}H_2O) = 408$, and criticise the molecular weight determinations of previous investigators, arguing that the use of acetic acid is "entirely inadmissible," since the substance cannot be recovered unchanged from the solution. Von Fürth (*Monatsh.*, 1903, **24**, 261) has shown that at least part of the substance can be obtained crystalline by ammonia after evaporating the acetic acid in a vacuum, and the authors have confirmed this observation.

That the loss of epinephrine is extremely small in acetic acid solution was shown by Dr. H. H. Dale, who, using a physiological method indicated by Elliott (*J. Physiol.*, 1905, **32**, 447), finds it possible to estimate epinephrine with an accuracy of about 5 per cent. This physiological method also served as a criterion for the purity of the epinephrine employed, the most active specimen obtained by repeated fractional precipitation with sodium carbonate and ammonia being selected.

The microscopic method of molecular weight determination (*Trans.*, 1905, **87**, 1756) was employed, with glacial acetic acid and with benzaldehyde, at a temperature of 90°.

(I) 0·0732 gram in 2·00 grams of acetic acid was intermediate between 0·19 and 0·214 gram-molecule of benzil per 1000 grams of solvent. M = 172—193.

(II) 0·1016 gram in 2·00 grams of acetic acid was intermediate between 0·166 and 0·18 gram-molecule of acetanilide per 1000 grams of solvent. M = 180—194.

(III) 0·0732 gram in 2·00 grams of acetic acid was intermediate between 0·205 and 0·21 gram-molecule of benzil per 1000 grams of solvent. M = 174—179.

(IV) 0·0732 gram in 2·00 grams of benzaldehyde was intermediate between 0·21 and 0·22 gram-molecule of benzil per 1000 grams of solvent. M = 167—174.

The mean of all these values is 179.

The epinephrine solutions in Experiments II and III were heated to 90° for ten minutes (the time during which the capillary tubes were heated), then diluted with water, nearly neutralised, and made up to 1 in 10,000. On comparison with a solution of the same strength, made by dissolving the solid epinephrine in the minimum quantity of hydrochloric acid, Dr. Dale could not trace any loss of physiological activity.

The value obtained by Jowett (*Trans.*, 1904, 85, 194) in a very dilute glacial acetic acid solution by the freezing-point method was 135, and by Bertrand (*Compt. rend.*, 1904, **139**, 502) was 174·3. It would appear, therefore, that Abel's formula should be abandoned.

28. "The critical temperature and value of $\frac{ML}{\Theta}$ of some carbon compounds." By James Campbell Brown.

The critical temperatures of a number of organic alcohols, acids, esters, and aromatic hydrocarbons are determined. The latent heats of the repurified substances have been redetermined, and the values of the constant $\frac{ML}{\Theta}$* are calculated for a number of these compounds for which this constant could not be given (*Trans.*, 1903, 83, 987, and *Trans.*, 1905, 87, 265). Two or three of the boiling points are given more correctly for the purified substances.

The value of $\frac{ML}{\Theta}$ rises very slightly with the increase of CH_2 in the aliphatic alcohols, acids, and esters, but is very constant for the aromatic hydrocarbons.

29. "Slow oxidations in the presence of moisture." By Norman Smith.

Experiments have been carried out to determine whether the oxidation of ammonia at the ordinary temperature in the presence of air and

* ML = molecular heat of vaporisation, Θ = absolute temperature of the boiling point.

water could be brought about (1) by catalysis, (2) by induced oxidation. The catalysts used were ferric oxide, stannic oxide, manganese dioxide, lead peroxide, and platinum. Stannic oxide and manganese dioxide produced both nitrite and nitrate from the ammonia (0·05 milligram of nitrate for 5 grams of oxide used); ferric oxide and lead peroxide gave only small amounts of nitrite and nitrate (0·01 milligram of nitrate), whilst platinum appeared to be without action. With platinum heated to a temperature just below dull redness, however, a very dilute solution of ammonia or ammonium salts was readily oxidised in presence of air. In the presence of copper or tin undergoing oxidation in air, ammonia was readily oxidised to nitrite and nitrate; zinc in some experiments gave positive, and in others negative, results, whilst ferrous and manganous hydroxides showed only traces of nitrite or nitrate. In the cases where the formation of nitrate was brought about by induced oxidation, the amount of nitrate produced was much greater than with catalysts.

The experiments were extended to the case of nitrogen. No evidence of oxidation of nitrogen by catalysts was obtained. In the presence of substances undergoing oxidation, the metals zinc, iron, and magnesium only among a large number of substances investigated gave ammonia, nitrite, or nitrate. These results were shown to be probably due to traces of nitride in the metals.

Water was evaporated in air under various conditions and it was shown that in no case was ammonium nitrite produced (compare Schönbein, *J. pr. Chem.*, 1861, **84**, 215, and others) if the following sources of error were avoided: (*a*) traces of nitrite in the air, (*b*) nitrites produced in the burning of flames, (*c*) presence of ammonium compounds or albuminoid matter in the water, (*d*) traces of nitride in the metals.

No hydrogen peroxide was produced in the evaporation of water under various conditions, except in presence of certain metals such as zinc, which undergo rapid oxidation at the same time.

30. "Fischer's salt and its decomposition by heat." By Prafulla Chandra Rây.

Fischer's salt as ordinarily prepared seems to correspond to the formula $Co_2(NO_2)_6,6KNO_2,3H_2O$. It is, however, invariably contaminated with appreciable traces of an oxide of cobalt. The method of Rosenheim and Koppel evidently does not yield a purer product as claimed by them. The salt when heated in a vacuum decomposes according to the following equation:

$$Co_2(NO_2)_6,6KNO_2,3H_2O = Co_2O_3 + 6NO + 3KNO_3 + 3KNO_2 + 3H_2O.$$

On this decomposition is based an accurate and expeditious method of analysing the compound.

31. "Action of quinones on *o*-diamines, *o*-nitroaniline, *m*-nitroaniline, and 2-nitro-*p*-toluidine. A preliminary note." By James Leicester.

In a previous paper (*Ber.*, 1890, **23**, 2793; Abstr., 1890, 1445), it was shown that the action of *o*-nitroaniline and 2-nitro-*p*-toluidine on benzoquinone, toluquinone, and naphthaquinone was the same in principle as that occurring in the case of aniline and benzoquinone. Quinonefluorindines and quinonephenazine derivatives were obtained on reduction with ammonium sulphide (Proc., 1893, **9**, 9).

Homofluorindine, $C_6H_4\langle\begin{matrix}NH\\N\end{matrix}\rangle C_6H_2\langle\begin{matrix}N\\NH\end{matrix}\rangle C_6H_4$, has been now prepared from quinonehomofluorindine,

$$C_6H_4\langle\begin{matrix}NH\\N\end{matrix}\rangle C_6O_2\langle\begin{matrix}N\\NH\end{matrix}\rangle C_6H_4,$$

by reduction with hydriodic acid (O. Fischer and E. Hepp, *Ber.*, 1890, **33**, 2789, and *Ber.*, 1888, **21**, 683). Various salts of the base have been made. Quinone-α-methylphenazine, $C_6H_2O_2\langle\begin{matrix}N\\|\\N\end{matrix}\rangle C_6H_3Me$, has also been reduced in a similar way. Some of the salts dissolve in alcohol with a deep blue colour and have a red fluorescence; the slightest trace of ammonia changes the colour to bright red with a strong fluorescence.

The absorption spectra of some of the compounds are under investigation with a view to the question of the origin of colour in organic compounds. Quinonephenotolazine,

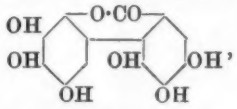
$$C_6HMeO_2\langle\begin{matrix}N\\|\\N\end{matrix}\rangle C_6H_4\ [N:N:Me=2:3:5],$$

naphthaquinonephenazine, $C_{10}H_4O_2\langle\begin{matrix}N\\|\\N\end{matrix}\rangle C_6H_4$, and α-naphthaquinonetolazine, $C_{10}H_4O_2\langle\begin{matrix}N\\|\\N\end{matrix}\rangle C_6H_3Me$, are also being examined in a similar manner.

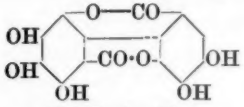
32. "Some oxidation products of the hydroxybenzoic acids. II." By Arthur George Perkin.

When gallic acid dissolved in 76 per cent. sulphuric acid is oxidised by means of potassium persulphate, a colouring matter very similar to

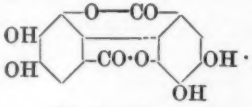
ellagic acid is produced. This substance, $C_{14}H_6O_9$, to which the name *flavellagic acid* is assigned, is obtained in yellow needles (m. p. above 360°) and dissolves in alkalis with a greenish-yellow coloration, and gives an *acetyl* compound, $C_{14}HO_9(C_2H_3O)_5$ (colourless needles, m. p. 317—319°), and a *benzoyl* derivative, $C_{14}HO_9(C_7H_5O)_5$ (prismatic needles, m. p. 287—289°). On distillation with zinc dust, it gives *fluorene*, and on digestion with boiling potassium hydroxide solution is converted into a substance, $C_{13}H_8O_8$ (m. p. above 360°), the alkaline solution of which develops a bluish-violet colour on oxidation. It crystallises with $1H_2O$ in almost colourless needles, gives an *acetyl* compound, $C_{13}H_2O_8(C_2H_3O)_6$ (prismatic needles, m. p. 232—234°), and a corresponding *benzoyl* derivative (m. p. 261—263°). The results indicate that this substance is *hexahydroxydiphenylmethylolid*,



and that flavellagic acid is *hydroxyellagic acid*.



Flavellagic acid.



Ellagic acid.

When gallic acid is oxidised in acetic acid by means of potassium persulphate and sulphuric acid, *ellagic acid* is formed, and this process is preferable to that in which concentrated sulphuric acid is employed as the solvent (*Proc.*, 1905, **21**, 185), owing to the simultaneous production in this case of a small quantity of flavellagic acid. These colouring matters could only be separated in the form of their benzoyl derivatives.

33. "Contributions to the chemistry of oxygen compounds. Part I. The compounds of tertiary phosphine oxides with acids and salts." By Robert Howson Pickard and Joseph Kenyon.

Tertiary phosphine oxides are easily prepared by the action of phosphorus oxychloride on organo-magnesium compounds. They combine with acids, metallic salts, and organo-magnesium iodides, forming compounds having the general formulæ $(R_3PO)_2,H_nX$; $(R_3PO)_2,M''X_2$; and $(R_3PO)_2,CH_3MgI$. The compounds described include some of those in which R is methyl, ethyl, propyl, phenyl, or benzyl, HX is

ferrocyanic, chloroauric, cobalticyanic, dichromic, camphoric, iodobismuthic, or iodomercuric acids, and $M''X_2$ is zinc chloride or iodide, cadmium iodide, mercuric or cobalt chlorides. Other compounds of the oxides which do not conform to these general formulæ are those with hydrochloric, trichloroacetic, pyruvic, and chloroplatinic acids and cupric chlorides. The constitution of these compounds is best explained by Werner's theory of oxonium compounds (*Annalen*, 1902, **333**, 296). The oxides are very weak bases. Their aqueous solutions do not affect the birotation of dextrose, and their compounds with acids are hydrolysed to a large extent by water.

34. "The rapid electro-analysis of metals. Preliminary note." By Henry Julius Salomon Sand.

A method for the rapid electro-deposition of metals for analysis and their separation by graded potential has been elaborated. Silver has thus been accurately separated from copper in about six minutes from boiling acetate solutions, more than half a gram being deposited without the use of an auxiliary electrode. Copper was separated from bismuth from a boiling tartrate solution (time: about eight minutes). An auxiliary electrode is necessary. The operation must be repeated once, as the first deposit contains traces of bismuth. Owing to the high stirring-efficiency of the electrodes, bismuth has been easily obtained in a perfectly adherent form from nitrate solutions, the time required being about ten minutes, with no auxiliary electrode. By treating the precipitation of bismuth as a separation from hydrogen, perfectly adherent metallic deposits have also been obtained from tartrate and acetate solutions (with the use of an auxiliary electrode). So far the deposition of the following metals has been studied and successfully carried out: copper with currents of ten amperes at about three volts, lead as peroxide, silver from boiling ammoniacal and acetate solutions, and bismuth.

At the next Ordinary Meeting, on **Thursday**, February **15th**, 1906, at **8.30** p.m., there will be a ballot for the election of Fellows, and the following papers will be communicated :

"Cuprous formate." By A. Angel.

"The solubility of triphenylmethane in organic liquids with which it forms crystalline compounds." By H. Hartley and N. G. Thomas.

"The spontaneous crystallisation of supersaturated solutions." By H. Hartley.

"The preparation and properties of some new tropeines." By H. A. D. Jowett and A. C. O. Hann.

"Studies in asymmetric synthesis. Part IV. The application of Grignard's reaction for asymmetric syntheses." By A. McKenzie.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Thursday, 15th February, 1906.

Banner, George Ernest,

"Brooklyn," Highfield Road, Rock Ferry, Cheshire.

Manager of Chemical Works, Bankhall, for Samuel Banner & Co., Ltd. Have been a student under Messrs. A. Norman Tate & Co. for some time and engaged in chemical work for the last ten years, also during the last 18 months I have been manager of Chemical Works for Messrs. Samuel Banner & Co., Ltd., Liverpool. I wish to join the Society so as to be in closer touch with the subject and obtain the Journal.

Francis Henry Tate. James Smith.
Alfred Smetham. *Wm. P. Thompson.*
Walter S. Spencer.

Barker, Arthur Ernest,

3, York Road, Chorlton-cum-Hardy, Manchester.

Schoolmaster. At present studying at University College, London. B.Sc. (London), B.A. (London). I wish to be able to obtain information as to recent work, and to keep up to date.

William Ramsay. Samuel Smiles.
J. Norman Collie. A. W. Stewart.
W. H. Edwards.

Bell, William Edward,

88, Monk's Road, Lincoln.

Chemist and Manager of Messrs. Tomlinson and Hayward's Chemical Works, Lincoln and Warrington. Studied in the laboratory of Messrs. A. Norman Tate & Co., Liverpool. Engaged in the examination of Coal Tar Oils, Crude Glycerines, Tobaccos, &c. I wish to obtain the latest chemical literature of the day.

Francis Henry Tate. — Alfred Shrubsole.
F. Percy Watson. — *H. Broadbent.*
W. Birkett.

Blatchley, Charles Frederick Polwhele,

Downside College, Bath.

Science Master at Downside College, near Bath. Second Class Honours, Final Honour School of Natural Science (Chemistry), Oxford, B.A. (Desirous of having the Journal of the Society.)

H. B. Baker. — John Watts.
Leonard G. Killby. — R. de J. Fleming-Struthers.
Andrea Angel. — J. E. Marsh.

Bogue, Thos. Going Stoney,

5, Kenilworth Square, Dublin.

M.P.S.I. I am a Member of the Pharmaceutical Soc. of Ireland, and have studied chemistry in Trinity College under Professors Young and Werner, and also in Mr. Armstedt Ray's laboratories. I am now chemist to Harvey & Co., Ltd., Wholesale Manufacturing Veterinary Chemists.

Sydney Young. — Wm. C. Ramsden.
Emil A. Werner. — J. Armstedt Ray.
David S. Jardin.

Braid, Arthur Forbes,

Rose Mount, Dumbreck, Glasgow; and 29, Hampton Road, Forest Gate, London, E.

Analytical Chemist. Five years with Messrs. Tatlock & Thomson. City Analysts, Glasgow, 2 years as student and 3 as assistant. Work included analyses of Iron, Tin, Manganese, Copper, and other ores, Iron, Steel, Copper, Brass, and other metals and alloys. Natural and Artificial Manures, &c. Sugars and Molasses, Oils, Fats, and Waxes, Waters and Assaying. Five years Glasgow Technical College training. At present chemist to the Charing Cross, West End, and City Electricity Supply Co., Ltd.

R. R. Tatlock. — G. G. Henderson.
R. T. Thomson. — Thomas Gray.
A. Humboldt Sexton.

Briggs, Richard Victor,

Sirseah Research Station, Mozufferpore P.O., Bengal.

Assistant, Sirseah Indigo Research Station. Assistant, five years, C. Rawson, Esq., F.I.C., F.C.S., Consulting and Analytical Chemist, Bradford. Connected with the chemistry of indigo in India from 1900–05. Medallist Honours Grade, Wool Dyeing, City and Guilds Institute. Student at Bradford Technical College.

Cyril Bergtheil. Walter M. Gardner.
Robert S. Finlow. *J. Walter Leather.*

D. Hooper.

Caldwell, William,

Mont-Cecil, Bloomfield, Belfast. Demonstrator, Physiological Department, Trinity College, Dublin. M.A., Royal University, Ireland.

Sydney Young. A. Louis Robinson.
Emil A. Werner. W. E. Adeney.
Wm. Cecil Ramsden. Cecil H. Desch.

Clarke, Reginald William Lane,

15, Torridon Road, Hither Green, London, S.E.

Demonstrator and Assistant Lecturer, Goldsmiths' College, New Cross. Studied for three years at the City and Guilds of London Institute, Technical College, Finsbury. Holder of College Certificate in Chemistry. Associate of the Institute of Chemistry. I have conducted research work with Professor Meldola and Dr. Lapworth.

R. Meldola. Arthur Lapworth.
John Castell-Evans. Arthur H. Coote.

F. Henry Streatfeild.

Conyngham, Wm. Boulton,

'Sandon,' Ballsbridge, Co. Dublin.

Pharmaceutical Chemist. Member of the Pharmaceutical Society of Ireland. Past student of the Royal College of Science, Ireland.

W. Palmer Wynne. *Sydney Young.*
W. N. Hartley. *Richard J. Moss.*
Peter MacEwan. *Emil A. Werner.*
James S. Ashe. *Wm. C. Ramsden.*

W. E. Adeney.

Courtauld, Stephen Lewis,

Bocking Place, Braintree.

B.A., Cantab., Natural Science Tripos, 1904. Engaged in research

in the Chemical Department of the Central Technical College, South Kensington.

Charles T. Heycock. William A. Davis.
Henry E. Armstrong. William Robertson.
Gerald T. Moody. Edward Horton.

Durrans, Thomas Harold,

1, Cornwall Terrace, Regent's Park, N.W.

Student. Studying Chemistry, Physics, &c., at the Birkbeck College, Chancery Lane, for B.Sc., Lond., with the object of becoming a Manufacturing Chemist. Member of the Faraday Society.

John E. Mackenzie. Frank E. Weston.
H. F. C. Goltz. F. Mollwo Perkin.
Alex. McKenzie.

Evans, Frederick Watkins,

3, Charlotte Street, Hull.

Pharmaceutical Chemist. I have been 2 years at the London College of Chemistry, 323, Clapham Road, and having obtained my M.P.S. and Ph.C. desire to pursue further work in Organic Chemistry.

John T. Griffiths. Henry Royal-Dawson.
Thomas Luxton. *T. A. Nightscales.*
Robert J. Porter. *David J. Williams.*

Fierz, Hans Eduard, Ph.D.,

Clydach on Tawe, Glamorg., Wales.

Chemist at the Mond Nickel Co., Ltd., Clydach. Three papers published together with M. O. Forster, D.Sc., Ph.D., F.R.S., in the Journal of the Chemical Society.

William A. Tilden. G. T. Morgan.
M. O. Forster. Chapman Jones.
James C. Philip.

Glover, Walter Hamis,

38, Ribblesdale Road, Streatham Park, S.W.

Assistant in the Chemical Department, Central Technical College, S. Kensington. Student, 1898—1901, and Junior Demonstrator, 1901—1902, at the Technical College, Finsbury. Studied, 1902—1903, at Würzburg University; and 1903—1905 at Leipzig University under Prof. Hantzsch, and obtained degree of Ph.D. (Leipzig), July, 1905.

Henry E. Armstrong. William A. Davis.
T. Martin Lowry. William Arthur Lethbridge.
Gerald T. Moody. John Vargas Eyre.

Hayworth, William Prince,

119, Clapton Common, London, N.E.

Senior Student in Chemical Department, Technical College, Finsbury, E.C. Certificated Student in Chem. Dept., City and Guilds Tech. Coll., Finsbury, E.C. Senior Student and Junior Demonstrator in Chem. Dept. of above College. Intermediate Associate of Institute of Chemistry Exam. (Pass). Matriculated Student of London University.

R. Meldola. John Castell-Evans.
Lawrence Briant. F. Southerden.
E. W. Bealey.

Irving, Henry Carlyle,

14, Heath Hurst Road, Hampstead, N.W.

Science Student. B.A. (Oxon.) in Chemistry; Marcon Hall [1903]. Engaged in Research Work at the Central Technical College, South Kensington.

Henry E. Armstrong. William A. Davis.
Gerald T. Moody. William Robertson.
Edward Horton.

Jones, Llewellyn Thomas,

Brenig View, Tregaron.

Science Master, County School, Tregaron. Three years' study Chemistry and Physics, University College of Wales, Aberystwyth. B.Sc., University of Wales. Two years Science Master, Tregaron County School.

J. J. Sudborough. F. D. Chattaway.
T. Campbell James. *J. Alan Murray.*
J. P. Millington.

Jones, William Henry Matthews,

Leyden Villa, Chester.

Deputy City Surveyor, Resident Engineer and Analyst in charge of the New Sewage Purification Works, Chester. Being the Analyst in charge of the Sewage Purification Works, and having to make Analyses of the Sewage in its Crude State, and during the various Stages of passing through the different Tanks and Filters before it enters the River Dee, and desiring to profit from the Study of the Publications and lectures of the Society, and to obtain, by visiting other similar works, that information on the subject essential for my purposes which would be more readily obtained if I were a Member of the Chemical Society.

Fredc. H. Bowman. John Welsh.
Edward Halliwell. W. A. Handcock.
W. F. Lowe. *Henry H. Whitehead.*

Le Rossignol, Robert,

2, Cæsarea Place, Jersey.

Research Student. B.Sc. Hons. Chem. "The Velocity Reaction between Potassium Ferricyanide and Potassium Iodide," in conjunction with Prof. Donnan, *Trans. Chem. Soc.*, 1902; "Rate of Decay of Thorium Emanation," in conjunction with C. T. Gimingham, *Phil. Mag.*, 1904.

J. Norman Collie. N. T. M. Wilsmore.
J. K. H. Inglis. Samuel Smiles.
Edward C. Cyril Baly.

McDowall, John,

Girdstingwood, Kirkcudbright, Scotland.

Analytical Chemist. One year study Heriot-Watt College (engineering), four years' study Edinburgh University (Chemistry); Foods and Drugs School of Medicine, Edinburgh. Chemist to Backus and Johnston, Co. At present Chemist to Henry J. Monson & Co., Upper Egypt.

Frank Hughes. G. H. Gemmell.
Alex. Crum Brown. Hugh Marshall.
Leonard Dobbin. J. P. Longstaff.

Martin, George Frederick Wesley,

14, Castle Park, Lancaster.

Acting Chemist to Messrs. Maudsley and Son, Chemical Manufacturers, Lancaster, and Organist of Parish Church. I have been a student of science for nine years, and am the inventor of a sheep dip approved by the Board of Agriculture. Former student at the Storey Institute, Lancaster. Have now a private laboratory where I take pupils. Being engaged in research work am anxious to keep in touch with progressive Chemical Science.

Henry Ross. *Percy F. Frankland.*
Rowland Williams. *Alex. Findlay.*
J. A. Storey. *Alex. McKenzie.*

Parfitt, Samuel,

33, Partridge Road, Cardiff.

Deputy and Assistant Manager (Engineering Works, Dry Dock, etc.). Long and careful researches in Siderology and the practical application of improved chemical methods to retard the corrosions in ingot iron and like materials.

F. Gwilym Treharne. Thomas Hughes.
Llewellyn J. Davies. *J. J. Beringer.*
R. W. Atkinson.

Parkin, John,

Blaithwaite, Carlisle.

M.A., Trinity College, Cambridge. Botanist, interested in the chemical side. 1st Class Nat. Sci. Tripos, Pt. I, 1894. 1st Class Nat. Sci. Tripos, Pt. II, 1895 (Botany and Chemistry). Papers:—"Carbohydrates of Monocotyledons," *Phil. Trans., R.S.*, Vol. 191, 1899; "On a Reserve Carbohydrate which produces Mannose from the bulb of Lilium," *Proc. Camb. Phil. Soc.*, Vol. XI, 1901; "India-rubber," *Circular, Roy. Bot. Gardens, Ceylon*, 1899. At present engaged in the study of the carbohydrates of plants.

Horace T. Brown. J. E. Purvis.
W. J. Sell. H. O. Jones.

George Dixon.

Perkins, William Hughes,

Harpur Hill, Nr. Buxton.

Demonstrator in Chemistry, The University, Leeds. B.Sc. (1st Class Honours), Manchester University, 1904.

Arthur Smithells. W. Lowson.
J. B. Cohen. C. E. Whiteley.

H. M. Dawson.

Pitman, John Edmund,

Hartley Univ. College, Southampton.

Asst. Lecturer and Demonstrator in Chemistry, Hartley Univ. College. Studied chemistry for 3 years (1900—1903) at the Hartley Univ. College, Southampton. Appointed Demonstrator and Asst. Lecturer, 1903, in above College. Hold the B.Sc. degree (Lond.) with Honours in Chemistry. Joint author with Prof. Boyd of "Note on Zeisel Reaction," *J.C.S.*, 1905.

D. R. Boyd. Geo. Fredk. Phillips.
A. Vernon Harcourt. W. T. L. Leeming.
J. Brierley. *C. F. Baker.*

Rogerson, Harold,

46, Bloomsbury St., Bedford Square, London, W.C.

Research Chemist in the Wellcome Chemical Research Laboratories, London, E.C. B.Sc. (Manchester), 1904. M.Sc. (exam.), 1905. For one year worked with Dr. J. F. Thorpe, Ph.D., at the Victoria University, Manchester, on "Some Alkyl Derivatives of Glutaconic Acid" and also "Some Alkyl Derivatives of Aconitic Acid."

Frederick B. Power. D. L. Chapman.
Harold B. Dixon. Wm. A. Bone.
W. H. Perkin, jun. J. F. Thorpe.

Alfred Holt, jun.

Rowsell, Philip Foale,

Nutbrook, Exmouth.

Analytical and Manufacturing Chemist. Principal of Holman, Ham & Co., Manufacturing Chemists, Exeter. Holder of Certificates in Chemistry under the Kensington Board and Pharmaceutical Society of Great Britain. Author of various articles, on antiquarian matters specially, and others. As a Chemist I desire admission to the Society for the use of Library and current literature as published by them.

William T. Bayne. Albert Cooper.
Harold W. Harrie. *E. J. Jackman.*
Isaac S. Scarf.

Shrimpton, John Kirby,

22, Fountains Terrace, North Rd., Ripon.

Chemist to Messrs. Robt. Kearsely & Co., varnish and colour makers, Ripon. I have studied at the South Western Polytechnic since 1901. I have held the post of Student Demonstrator during the session 1904–5, when I conducted several investigations in conjunction with Professor J. B. Coleman.

S. Skinner. W. E. Oakden.
J. B. Coleman. F. H. Lowe.
J. C. Crocker.

Smith, Frank,

407, Church Rd., Smithills, Bolton.

Science Master. Graduated in Science (Chemistry and Physics) at the Victoria University, Manchester (1903). Teaching chemistry at Bolton Municipal Secondary School. Lecturer in chemistry at Bolton P.T.'s Centre. Wishes to receive Society's publications.

Harold B. Dixon. Norman Smith.
W. H. Perkin, jun. D. L. Chapman.
Wm. A. Bone. G. H. Bailey.

Thornton, Percy Charles,

9, Cantwell Rd., Plumstead, S.E.

Science Demonstrator under the Liverpool Education Committee. I was a Student for little more than 2 years in the Laboratory of University College (1902—1904). Was appointed Student Demonstrator in Chemistry there, relinquishing this post to become Asst. Chemist in Royal Arsenal, Woolwich (1904—1905).

William Ramsay. J. K. H. Inglis.
J. Norman Collie. N. T. M. Wilsmore.
Edward C. Cyril Baly.

Thorp, Arthur William,

210, Sherborne Road, Yeovil.

Analytical Chemist. Assistant in the Laboratory of Mr. Walter Thorp, F.I.C. (Drug Analyst to the Irish Local Government Board), for 7 years; Chemist to Aplin and Barrett, Ltd., for 3 years; is a Member of the Society of Public Analysts.

W. H. Hurtley. H. Droop Richmond.
Walter Thorp. *E. H. Miller.*
Otto Rosenheim.

Tonkin, Ronald William,

37, Oakhill Road, Putney, S.W.

Chief Chemist to the Imperial Tobacco Co., of York Road, St. Luke's. Studied for 3 years at the Central Technical (City and Guilds of London) College, Kensington.

Henry E. Armstrong. William A. Davis.
Gerald T. Moody. William Robertson.
Robert J. Caldwell.

Walker, Franklin Wilfred,

39, Graham Rd., Acton Green, London, W.

Dyers' Chemist. First Class Certificates in Advanced Organic and Inorganic Chemistry; First Class Honours in Wool, Silk, and Cotton Dyeing (City and Guilds of London), with Institute's Silver Medal in each case. Formerly for 3 years Junior Assistant in Dyeing Dept., Yorks. College (now Univ. of Leeds), under late Prof. Hummel. Now Chemist to Messrs. Eastman & Son, Dyers and Cleaners, London. Author of paper on "Bleaching and Stripping Agents," *Journ. Soc. Dyers and Colourists*, Jan. 1905. Wish to keep informed of recent Chemical Research.

A. G. Green. Reginald B. Brown.
A. G. Perkin. M. C. Lamb.
F. E. Robertson.

Warren, Richard Alfred,

"Belle Vue," Hallow Road, Worcester.

A Brewer with Messrs. Hill, Evans & Co., Ltd., Vinegar Works, Worcester. Five years student of Chemistry at the Victoria Institute, Worcester. First Class Advanced and First Class, Stage III, Practical Inorganic Chemistry, South Kensington.

Cecil Cooke Duncan. G. Percy Bailey.
J. Hector Barnes. *Bernard Dyer.*
T. Slater Price.

Watt, Henry Edgar,

19, Summerhill Road, Dartford, Kent.

Chemist, Messrs. Burroughs, Wellcome & Co., Dartford, Kent. Bachelor of Science (Honours in Chemistry, 1900); Master of Science, 1902, Durham University, also Freire-Marreco Prizeman and Medallist and Johnston Chemical Research Scholar (Durham University). Associate of the Institute of Chemistry (Branch "E").

P. Phillips Bedson. S. Hoare Collins.
F. C. Garrett. F. H. Lees.
H. A. D. Jowett.

Wechsler, Elkan,

59, Petherton Road, Canonbury, N.

Demonstrator in Chemistry at the Goldsmiths' College, New Cross. I studied at the City and Guilds Technical College, Finsbury, and at the Würzburg University, and have carried out researches under Professors R. Meldola and A. Hantzsch. I graduated at the Würzburg University, taking the Ph.D. degree.

R. Meldola. Arthur Lapworth.
John Castell-Evans. L. Eynon.
F. Henry Streatfeild.

Wheaton, Harold Joseph,

21, Chesterton Road, Cambridge.

Chemical Engineer. I have taken the Chemistry course in connection with Engineering at the Central Technical College, and have since held positions as Assistant Analyst in the Thames Conservancy and Kennicott Water Softener Co.'s Laboratories.

Charles E. Groves. Gerald T. Moody.
Henry E. Armstrong. William A. Davis.
T. Martin Lowry.

Willett, Herbert William Mills,

The Cedars, Chislehurst. During term: Magdalen College, Oxford.

Student of Chemistry at the University of Oxford.

Henry A. Miers. D. H. Nagel.
Harold Hartley. N. V. Sidgwick.
H. B. Baker.

Willstaetter, Richard,

Zürich (V Bergstrasse 25).

Ph.D. Professor of Chemistry, Polytechnicum, Zürich.

George Lunge. M. O. Forster.
W. H. Perkin, jun. Rudolf Lessing.
William Ramsay. *James Dewar.*
Raphael Meldola.

Wolfe, Ernest Edwin,

Kinsale, Co. Cork, Ireland.

Pharmaceutical Chemist. Member of Pharmaceutical Society, Ireland. Teacher of Practical and Theoretical Chemistry.

J. Armstedt Ray. S. V. O'Connor.
P. J. Fielding. *David S. Jardin.*

Francis Dickinson.

Yates, John William,

71, North Street, Hugglescote, Nr. Leicester.

Science Master, Market Bosworth Grammar School, Nr. Nuneaton. I have been through the course of Chemistry at the Royal College of Science, taking the final for the A.R.C.Sc. in that subject. Have passed the B.Sc. with Honours in Chemistry. As Science Master in the above School, I wish to keep well in touch with recent chemical work and investigations. Oxford Senior, First Class. College of Preceptors, 1st Class Honours (7th). Board of Education Exams.

William A. Tilden. Chapman Jones.
M. O. Forster. James C. Philip.

G. T. Morgan.

The following Certificates have been authorised by the Council for presentation to Ballot under Bye-law I (3):

Grindley, Harry Sands,

Urbana, Illinois.

Professor of General Chemistry, State University of Illinois. B.Sc., University of Illinois, 1888. D.Sc., Harvard University, 1894. Author and joint author of various publications in the German Chemical Society Proceedings, American Chemical Journal; Journal of the American Chemical Society, U.S. Department of Agric. Bulletins, "University Studies" (University of Illinois publications).

Sidney Calvert.

Mace, William,

Hope, Kingston, Jamaica.

Lecturer in Agricultural Science, Board of Agriculture, Jamaica, 1905, now (1906) Chemist, Amity Hall Sugar Factory, Ltd. Desire to be in touch with modern work and Chemical research.

H. H. Cousins.

Talbot, George Stanley,

Ocean Island, c/o P.P. Co., 60a, Pitt Street, Sydney, N.S.W.

Analytical Chemist. Student for three years and four months under the training and instruction of W. A. Dixon, Esq., F.I.C., and Messrs.

Dixon and Byrn, Analysts under the Public Health Act, N.S.W. For the last two years, and at present, Chief Analyst to the Pacific Phosphate Co., Ltd., Sydney, N.S.W. Desire membership to keep in touch with current chemical literature.

George A. Byrn. Will. A. Dixon.
Andrew J. Dixon.

Wastenays, Hardolph,
Brisbane, Queensland.

Analyst, Brisbane Board of Waterworks. Primary Chemical Training, Demonstrator, Chemistry, 2 years, College of Pharmacy, Brisbane. Assistant Government Analyst, Q., under J. Brownlie Henderson, F.I.C., F.C.S. (seven years, February, 1897, to January, 1904). Analyst to Brisbane Board of Waterworks (January, 1904, to date). Paper before Royal Society, Q., August, 1905 ("Description of Enoggera Reservoir, Brisbane, and Methods of rendering it fit for a Town Supply").

J. C. Brünnich. P. W. Jones.
J. Brownlie Henderson. W. A. Hargreaves.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 23/2/06

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 305.

Thursday, February 15th, 1906, at 8.30 p.m. Professor R. MELDOLA, F.R.S., President, in the Chair.

Messrs. H. B. Hartley and H. L. Tidy were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.:

Richard Henry Beckett, B.Sc., Inval, Haslemere, Surrey.
Herbert Reginald Cooper, Redington, Northwood, R.S.O.
Charles Davidson, 37, Herriot Street, Pollokshields, Glasgow.
Edward Gardner, 70, Parliament Hill Mansions, Highgate Road, N.W.
Richard Godfrey Hamilton Garvey, 25, Park Mansions, Battersea.
William Tabor Lattey, Corpus Christi College, Cambridge.
Hamilton McCombie, M.A., B.Sc., Ph.D., The University, Birmingham.
Thomas Jenkins Murray, Ph.D., The University, Birmingham.
Edgar Gall Oliver, M.A., Chigwell School, Essex.
Lawrence George Richardson, 14, Ashgrove, Horton, Bradford.
David Sommerville, B.A., M.D., 31, Manor House, Marylebone.
Foster Sproxton, B.Sc., Uplands, Alexandra Park Road, Wood Green, N.
Harold Augustine Tempany, B.Sc., St. Johns, Antigua, B.W.I.

It was announced that the following changes in the Officers and Council were proposed by the Council.

As Vice-Presidents: Prof. W. H. Perkin, jun., F.R.S., and Dr. Rudolph Messel, *vice* Prof. W. R. Dunstan, F.R.S., and Mr. D. Howard.

As Ordinary Members of Council: Prof. W. Gowland, Dr. H. A. D. Jowett, Dr. F. E. Matthews, and Prof. A. G. Perkin, F.R.S., *vice* Prof. A. E. Dixon, Prof. J. J. Dobbie, F.R.S., Dr. E. J. Mills, F.R.S., and Prof. J. M. Thomson, F.R.S.

Mr. E. Grant Hooper, Dr. H. F. Morley, and Dr. H. R. Le Sueur were elected Auditors to audit the Society's accounts.

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected.

George Ernest Banner.
Arthur Ernest Barker, B.A., B.Sc.
William Edward Bell.
Charles Frederick Polwhele Blatchley, B.A.
Thos. Going Stoney Bogue.
Arthur Forbes Braid.
Richard Victor Briggs.
William Caldwell, M.A.
Reginald William Lane Clarke.
Wm. Boulton Conyngham.
Stephen Lewis Courtauld, B.A.
Thomas Harold Durrans.
Frederick Watkins Evans.
Hans Eduard Fierz, Ph.D.
Walter Hamis Glover, Ph.D.
Harry Sands Grindley, D.Sc.
William Prince Hayworth.
Henry Carlyle Irving, B.A.
Llewellyn Thomas Jones, B.Sc.
William Henry Matthews Jones.
Robert Le Rossignol, B.Sc.
John McDowall.
William Mace.
George Frederick Wesley Martin.
Samuel Parfitt.
John Parkin, M.A.
William Hughes Perkins, B.Sc.
John Edmund Pitman, B.Sc.
Harold Rogerson, M.Sc.
Philip Foale Rowsell.
John Kirby Shrimpton.
Frank Smith, B.Sc.
George Stanley Talbot.
Percy Charles Thornton.
Arthur William Thorp.
Ronald William Tonkin.
Franklin Wilfred Walker.
Richard Alfred Warren.
Hardolph Wastenays.
Henry Edgar Watt, M.Sc.
Elkan Wechsler, Ph.D.
Harold Joseph Wheaton.
Herbert William Mills Willett.
Richard Willstaetter, Ph.D.
Ernest Edwin Wolfe.
John William Yates, B.Sc.

Of the following papers, those marked * were read:

***35. "Cuprous formate." By Andrea Angel.**

The compound described as cuprous formate by Joannis (*Abstr.*, 1904, i, 644), having the formula $(HCO_2)_2Cu_2,4NH_3,\frac{1}{2}H_2O$, should be named ammonio-cuprous formate, since it is quite different in properties from the substance prepared by dissolving cuprous oxide in an aqueous ammoniacal solution of ammonium formate under petroleum, diluting the solution with alcohol, and acidifying with

formic acid, when crystals are deposited which are collected in an atmosphere of hydrogen and washed with ethyl formate. *Cuprous formate*, $(HCO_2)_2Cu_2$, consists of colourless crystals which are very easily decomposed; water immediately hydrolyses the substance to cuprous oxide and formic acid, sodium carbonate solution decomposes it with effervescence, ammonia solution decomposes it with a slight hissing noise, and dilute sulphuric acid at once produces a precipitate of metallic copper. Dilute formic acid acts similarly, although more slowly. Moist air rapidly hydrolyses it, turning it orange-red, but in a desiccator over sulphuric acid it may be preserved apparently for an indefinite time. Owing to the ease with which the substance is decomposed, the preparation requires special precautions in regard to the strength of the solutions employed. The method of preparation may be employed, with modifications, for the production of other cuprous salts.

DISCUSSION.

MR. A. VERNON HARCOURT said that Mr. Angel's research arose out of some experiments on the gradual heating of cupric acetate in a vacuum, an account of which had already appeared in the *Transactions*.

Both cupric acetate and cupric formate when strongly heated in a glass vessel deposit a mirror of copper on the glass, showing that a gas containing copper has been formed. The temperature of decomposition of cuprous acetate is very near its temperature of volatilisation, and neither it nor cuprous formate can be obtained, except in very small proportion, by sublimation from the cupric salt.

***36. "The solubility of triphenylmethane in organic liquids, with which it forms crystalline compounds." By Harold Hartley and Noel Garrod Thomas.**

Experiments were made on the crystallisation of triphenylmethane from a large number of organic liquids in order to see in what cases a crystalline compound is formed with the solvent. From benzene, thiophen, pyrrole, and aniline solutions, it crystallises under certain conditions with one molecule of the solvent, and a microscopic study of crystals of the four compounds has shown that they all belong to the rhombohedral system, forming an isomorphous series.

The solubility of triphenylmethane in each of the four liquids and also in pyridine has been determined by a modification of the method devised by Kuriloff. Weighed quantities of solvent and solute are sealed in small glass tubes, and these are placed in a water-bath. By varying the temperature of the bath, two temperatures can be determined, at the lower of which the last crystal left undissolved is

growing, and at the upper the same crystal is dissolving. These temperatures are usually 0·4° to 0·5° apart and their mean has been taken as the temperature of saturation.

Experiments were also made on the spontaneous crystallisation of supersaturated solutions of triphenylmethane in each of the foregoing solvents by cooling solutions in sealed tubes after they had been heated sufficiently to destroy all crystalline nuclei. When the tubes were shaken during the cooling, crystallisation took place at definite temperatures. The results confirm the existence of a metastable region in which supersaturated solutions cannot crystallise spontaneously. The limit of this region where the solutions pass into the labile state and crystallise can be represented by a curve, for which Miers and Isaac have suggested the name "supersolubility curve." It runs approximately parallel to the solubility curve at a distance from it depending on the respective solvent and solute.

***37. "The spontaneous crystallisation of supersaturated solutions." By Harold Hartley.**

The author discussed the different views of Ostwald and de Coppet on this subject in view of the experiments described in the preceding communication and those of Miers and Isaac (Proc., 1906, **22**, 9). It was shown how the difference between metastable and labile solutions might be explained from the kinetic standpoint as a result of the increased solubility of the small crystals which must be first formed in a spontaneous crystallisation.

Discussion.

Professor Miers welcomed these investigations as new examples of the importance of the supersolubility curve, and called attention to the fact that the authors could not have established their results without a practical knowledge of crystallography.

Sir William Ramsay pointed out the analogy between the behaviour of crystallisable solution in the metastable and stable states with that of a super-heated liquid, and suggested that Mr. Hartley might derive some help by a study of such behaviour.

Mr. Hartley, in reply, said that small crystals besides being abnormally soluble must also have a lower melting point than larger individuals, and that this fact would explain the usual occurrence of superfusion. Mr. P. W. Robertson and he were just starting to investigate the conditions under which a number of pure organic substances crystallise spontaneously, and the former had suggested that the variation of melting point with the size of a crystal

might explain some of the irregularities which had been observed in cryoscopic work with such solvents as thymol. Supersaturated solutions did not crystallise immediately on reaching the labile state unless they were vigorously shaken; thus the pull on the solution, which was suggested by Sir William Ramsay's analogy of the continuous isothermal as necessary to start crystallisation, was actually realised in the continuous production of fresh liquid surfaces.

***38. "Preparation and properties of some new tropeines." By Hooper Albert Dickinson Jowett and Archie Cecil Osborn Hann.**

The object of this investigation was primarily to determine whether any difference in physiological action could be observed between tropeines containing a lactone grouping and their corresponding hydroxy-acid, similar to that recorded in the case of pilocarpine and pilocarpic acid (Marshall, *J. Physiol.*, 1904, **31**, 153). For this purpose, the tropeines of methylparaconic, terebic, and phthalidecarboxylic acids were prepared, when it was found that both terebyl- and phthalidecarboxyl-tropeines, which produce an atropine-like effect on the heart, lose this action after a molecular proportion of alkali has been added to the base, thus showing in aqueous and alkaline solution a difference in action analogous to that observed in the case of pilocarpine.

In addition to the tropeines already mentioned, the glycollyl- and protocatechyl-derivatives were prepared and the opportunity taken to test Ladenburg's generalisation. According to this chemist, a tropeine, in order to possess mydriatic action, must contain a benzene nucleus and a fatty hydroxyl attached to the same carbon atom as that bearing the carboxyl group. It was found that this did not strictly hold, as terebyltropeine possessed a distinct mydriatic action. It would appear, however, that the conditions most favourable for the development of the mydriatic action in a tropeine are those stated by Ladenburg, namely, that the acyl group should contain a benzene nucleus and an aliphatic hydroxyl in the side-chain containing the carboxyl group.

***39. "Studies in asymmetric synthesis. IV. The application of Grignard's reaction for asymmetric syntheses." By Alexander McKenzie.**

The author has studied the action of magnesium propyl iodide, magnesium *iso*butyl iodide, and magnesium α-naphthyl bromide respectively on *l*-menthyl benzoylformate and effected in each case an asymmetric synthesis of a substituted *l*-glycollic acid. The influence of the *l*-bornyl as contrasted with that of the *l*-menthyl grouping was

examined by acting on *l*-bornyl benzoylformate with various magnesium alkyl halides; the effect of the *l*-bornyl grouping was to diminish the lævorotation of the mixture of substituted glycollic acids obtained; thus, whilst the mixture of *d*- and *l*-atrolactinic acids obtained from *l*-menthyl benzoylformate and magnesium methyl iodide had $[\alpha]_D$ −9·5° in ethyl-alcoholic solution, the mixture from *l*-bornyl benzoylformate under similar conditions gave $[\alpha]_D$ −1·9°.

A mixture of *d*- and *l*-phenyl*iso*butylglycollic acids containing an excess of the *d*-acid was produced from *l*-bornyl benzoylformate and magnesium *iso*butyl iodide, whereas the mixture was lævorotatory when *l*-menthyl benzoylformate was used. Similarly, a dextrorotatory mixture of acids was produced by the action of *l*-bornyl benzoylformate on magnesium α-naphthyl bromide.

The asymmetric synthesis of *d*-atrolactinic acid was produced by the action of magnesium phenyl bromide on *l*-menthyl pyruvate.

When *l*-menthyl acetoacetate, *l*-menthyl ethylacetoacetate, or *l*-menthyl diethylacetoacetate is submitted to the Grignard reaction, no asymmetric synthesis occurs, the first of these substances reacting in accordance with its enolic structure. A slight asymmetric synthesis was, however, detected when *l*-menthyl lævulate was used.

40. "*o*-Cyanobenzenesulphonic acid and its derivatives." By A. Jamieson Walker and Elizabeth Smith.

Reference was made to the work of Jesurun (*Ber.*, 1893, **26**, 2288) on *o*-cyanobenzenesulphonic chloride, and to that of Remsen and others (*Amer. Chem. J.*, 1895, **17**, 309 and 347; *ibid.*, 1896, **18**, 794 and 819) and List and Stein (*Ber.*, 1898, **31**, 1648) on ammonium *o*-cyanobenzenesulphonate.

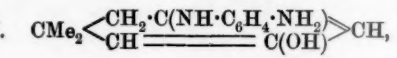
The authors then described a modification of Jesurun's method for the preparation of *o*-cyanobenzenesulphonic chloride and the isolation from the mother liquor of *o-cyanobenzenesulphonic acid*, $CN\cdot C_6H_4\cdot SO_3H$, which crystallises from water in white needles melting at 279—279·5°. Its silver salt has been prepared, and the action of nitric acid and bromine on the acid investigated.

Reduction of the chloride with zinc dust yields *o-cyanobenzenesulphinic acid*, $CN\cdot C_6H_4\cdot SO_2H$, which crystallises in small, white needles melting at 226·5—228°. With bromine, this acid yields two compounds melting at 156—156·5° and 172·5—173° respectively, but containing no bromine. Their constitution is still being investigated. Nitrous acid converts the sulphinic acid into a yellow solid, probably *o-cyanodibenzsulphohydroxamic acid*, $N[C_6H_4(CN)\cdot SO_2]_2\cdot OH$.

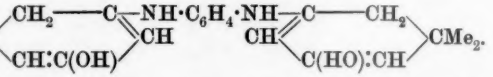
Heating with dilute caustic soda and subsequent acidification transform the chloride into a substance (m. p. 221·5—223°) with the sweet taste of "saccharin," and not into the sulphonic acid.

41. "The condensation of dimethyldihydroresorcin and of chloroketodimethyltetrahydrobenzene with primary amines. Part II. Diamines.—*m*- and *p*-Phenylenediamines." By Paul Haas.

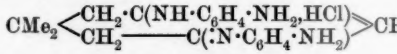
Dimethyldihydroresorcin condenses, in alcoholic solution, with one molecular proportion of a diamine, giving an 80 per cent. yield of the compound



together with a small amount of a disubstituted amine having the formula



A better yield of the latter substance is obtained by prolonged boiling in alcoholic solution of one molecular proportion of the compound I with a second molecule of dimethyldihydroresorcin. Chloroketodimethyltetrahydrobenzene condenses with two molecules of a primary diamine to give a hydrochloride having the following formula:



The corresponding base is strongly alkaline to litmus, whereas the compound I has a neutral reaction; it cannot be made to condense further with dimethyldihydroresorcin as, owing to its strongly basic nature, it is precipitated by this substance from an alcoholic solution in the form of an insoluble resorcin salt having the formula

$$C_{20}H_{24}N_4,C_8H_{12}O_2.$$

42. "A modification of the volumetric estimation of free acid in the presence of iron salts." By C. Chester Ahlum.

Because of the inapplicability of indicators in the titration of free acid in the presence of iron salts, the author devised a modification in which the iron is removed from solution, making a titration possible. The iron is precipitated by means of sodium dihydrogen phosphate. The iron phosphates are filtered off and the filtrate titrated with standard sodium hydroxide. In the reaction of the ferric salt with the sodium dihydrogen phosphate, a definite quantity of acid is liberated, necessitating a correction in the amount of acid found in the titration.

$$Fe_2(SO_4)_3 + 2NaH_2PO_4 = 2FePO_4 + Na_2SO_4 + 2H_2SO_4.$$
$$Fe_2Cl_6 + 2NaH_2PO_4 = 2FePO_4 + 2NaCl + 4HCl.$$

The amount of acid is directly proportional to the amount of ferric iron present, the latter being estimated previous to the titration. The difference between the amount of acid found in the titration and the amount of acid equivalent to the ferric iron present gives the true amount of free acid. A table giving the results of a number of estimations of free acid in mixtures of known quantities of ferric sulphate and sulphuric acid shows a considerable degree of accuracy.

Calcium, magnesium, and ferrous salts do not interfere with the estimation, and the method is applied to the analysis of natural waters containing iron salts and free acid.

43. "The theory of alkaline development, with notes on the affinities of certain reducing agents." By Samuel Edward Sheppard.

The author first dealt with the reactions of hydroxylamine and hydrogen peroxide respectively with silver salts, with notes on the reactions of organic reducers. It was shown that at moderate concentration one molecule of hydroxylamine reduces one molecule of silver salt, but at great dilutions two, according to the equations:

$$2NH_2{\cdot}OH + Ag_2O = 2Ag + N_2 + 3H_2O\ ;$$

$$2NH_2{\cdot}OH + 2Ag_2O = 4Ag + N_2O + 3H_2O,$$

whilst one molecule of hydrogen peroxide reduced one molecule of silver salt, probably according to the equation:

$$2H_2O_2 + Ag_2O = 2Ag + H_2O + 2O_2 + H_2,$$

hydrogen being one of the reaction products. The bearing on the molecular condition in solution of these substances was discussed. With organic reducers, such as polyphenols and aminophenols, a peculiar case of "coupled" reaction was examined, wherein the mutual presence of organic compound and sulphite retarded the total oxidation. The author has also investigated the dynamics of development with these reducers.

44. "Resolution of 2 : 3-dihydro-3-methylindene-2-carboxylic acid into its optically active isomerides." By Allen Neville.

When ethyl benzylacetoacetate is treated with concentrated sulphuric acid, 3-methylindene-2-carboxylic acid is formed, which on reduction with sodium amalgam gives 2 : 3-dihydro-3-methylindene-2-carboxylic acid. This acid forms with *l*-menthylamine a well-defined crystalline salt, which on crystallisation from ethyl acetate gives, after a few crystallisations, the pure salts of the *d*-acid and *l*-base. This substance crystallises in long, white needles, melts at 170°, is easily

soluble in all the ordinary organic media except ethyl acetate and ether, and has $[\alpha]_D$ +27·35° and $[M]_D$ +89·63°. On decomposing this salt, *d*-2 : 3-dihydro-3-methylindene-2-carboxylic acid was obtained, which crystallised in long, flat needles melting at 86°. It was insoluble in water, but soluble in all the ordinary organic media ; it gave in alcohol $[\alpha]_D$ +67·28° and $[M]_D$ +118·41°, and in benzene $[\alpha]_D$ +76·86° and $[M]_D$ +135·27°. The *sodium*, *potassium*, *barium*, *silver*, and *lead* salts and the *methyl* ester were prepared.

From the more readily soluble portions of the menthylamine salt, the lævorotatory acid was isolated. This was exactly similar in specific rotation and other properties to the corresponding dextrorotatory isomeride.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Aaron, *C. H.* Assaying. 2 vols. pp. 142, 170. ill. San Francisco 1900. (*Recd.* 13/2/06.) From Bennett H. Brough, Esq.

Baeyer, *Adolf von.* Gesammelte Werke. Herausgegeben zur Feier des siebzigsten Geburtstages des Autors von seinen Schülern und Freunden. 2 vols. pp. cxxxii + 990, 1195. Braunschweig 1905. (*Recd.* 13/2/06.) From the Publishers : Messrs. Vieweg & Son.

Baumert, *Georg*, **Dennstedt**, *M.*, und **Voigtländer**, *F.* Lehrbuch der gerichtlichen Chemie. Band II. Der Nachweis von Schriftfälschungen, Blut und Sperma. pp. x + 248. ill. Braunschweig 1906. (*Recd.* 13/2/06.) From the Publishers : Messrs. Vieweg & Son.

Bernthsen, *A.* Kurzes Lehrbuch der organischen Chemie. 9th edition. Edited by *Ernst* **Mohr**. pp. xxi + 638. Braunschweig 1906. (*Recd.* 13/2/06.) From the Publishers : Messrs. Vieweg & Son.

Crookes, *Sir William.* Select methods in chemical analysis (chiefly inorganic). 4th edition. pp. xxiv + 738. ill. London 1905. (*Recd.* 10/2/06.) From the Author.

—— The wheat problem. Based on remarks made in the presidential address to the British Association at Bristol in 1898. Revised with an answer to various critics. With two chapters on the future wheat supply of the United States, by *C. Wood* **Davis** and the Hon. *John* **Hyde**. 2nd edition. pp. xii + 229. London 1905. (*Recd.* 10/2/06.) From the Author.

Faust, *Edwin Stanton.* Die tierischen Gifte. pp. xiv + 248. Braunschweig 1906. (*Recd.* 13/2/06.)
From the Publishers : Messrs. Vieweg & Son.

Goppelsroeder, *Friedrich*. Anregung zum Studium der auf Capillaritäts- und Adsorptionserscheinungen beruhenden Capillaranalyse. pp. 239. Basel 1906. (*Recd.* 19/1/06.) From the Author.

Ostwald, *Wilhelm*. Conversations on chemistry. Part II. The chemistry of the most important elements and compounds. Authorised translation by *Stuart K.* **Turnbull**. pp. viii + 373. ill. New York. 1906. (*Recd.* 30/1/06.) From the Publishers : Messrs. Wiley & Sons.

Parry, *Laurent*. Die analytische Bestimmung von Zinn und Antimon. pp. 78. Leipzig 1906. (*Recd.* 13/2/06.)
From Bennett H. Brough, Esq.

II. *By Purchase.*

Bio-chemical Journal. Edited by *Benjamin* **Moore** and *Edward* **Whitley**. Vol. I, No. 1. Liverpool 1906. (*Reference.*)

Czapek, *Friedrich*. Biochemie der Pflanzen. 2 vols. pp. xv + 584, xii + 1027. Jena 1905. (*Recd.* 13/2/06.)

Moeller, *Josef*. Mikroskopie der Nahrungs-und Genussmittel aus dem Pflanzenreiche. 2nd edition. pp. xvi + 599. ill. Berlin 1905. (*Recd.* 13/2/06.)

Stillman, *Thomas B.* Engineering chemistry : a manual of quantitative chemical analysis. 3rd edition. pp. xxii + 597. ill. Easton, Pa. 1905. (*Recd.* 2/2/06.)

Treadwell, *F. P.* Analytical chemistry. Volume I. Qualitative analysis. Translated by *William T.* **Hall**. pp. xi + 466. ill. New York 1905. (*Recd.* 27/1/06.)

Wieler, *A.* Untersuchungen über die Einwirkung schwefliger Säure auf die Pflanzen. pp. vii + 427. ill. Berlin 1905. (*Recd.* 13/2/06.)

III. *Pamphlets.*

Baker, *Richard T.*, and **Smith**, *Henry G.* Some West Australian eucalypts and their essential oils. (From the *Pharm. J.*, **21**, 1905.)

Juritz, *Charles F.* The need for organised chemical research in the Cape Colony. pp. 23. Cape Town [1905].

—— Some notes regarding South African pharmacology. (From the *Trans. S. African Phil. Soc.*, **16**, 1905.)

Smith, *Henry G.* The refractive indices, with other data, of the oils of 118 species of eucalyptus. (From the *J. and Proc. Roy. Soc. N.S. Wales*, **39**, 1905.)

—— On the occurrence of calcium oxalate in the barks of the eucalypts. (From the *J. and Proc. Roy. Soc. N.S. Wales*, **39**, 1905.)

At the next Ordinary Meeting, on **Thursday**, March **1st**, 1906, at **8.30** p.m., the following paper will be communicated:

"Studies of dynamic isomerism. Part IV. Stereoisomeric halogen derivatives of camphor." By T. M. Lowry.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 9/3/06

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. **No. 306.**

Thursday, March 1st, 1906, at 8.30 p.m. Mr. A. G. VERNON HARCOURT, F.R.S., Past President, in the Chair.

Messrs. A. T. Braid, H. E. Fierz, W. P. Hayworth, H. A. D. Neville, F. W. Walker, E. Wechsler, and J. L. White were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. :

Edwin Rodney Chrystall, Forest Villa, Prince's Road, Buckhurst Hill, Essex.

Robert K. Duncan, University of Kansas, U.S.A.

Ernest Feilmann, B.Sc., Ph.D., F.I.C., 2A, Dartmouth Road, Brondesbury, N.W.

James Louis Foucar, B.Sc., 20, St. John's Park, Blackheath, S.E.

Richard John Hall, M.Sc., F.I.C., "Sandycroft," Serpentine Road, Egremont, Liverpool.

Walter Daly Scouller, B.Sc., 7, Stamp Office Place, Wakefield.

James Frederick Spencer, M.Sc., Ph.D., 134, Rice Lane, Walton, Liverpool.

Francis W. Storey, B.Sc., 42, Ellerdale Street, Lewisham, S.E.

George Augustus Turner, "Alma House," Strandtown, Belfast.

A certificate has been authorised by the Council for presentation to ballot under Bye-Law I (3) in favour of :

Hem Chandra Dutt Gupta, "Guptanibar," Krishnagar, Bengal, India.

Of the following papers, those marked * were read:

***45. "Studies of dynamic isomerism. Part IV. Stereoisomeric halogen derivatives of camphor." By Thomas Martin Lowry.**

Measurements were given of the solubility in alcohol of α-chloro- and α-bromo-camphors, αβ- and απ-dibromocamphors, and αβ- and απ-chlorobromocamphors, both alone and in presence of a small proportion of sodium ethoxide. In each case it was found that the addition of alkali resulted in an increase of solubility in the ratio of about 0·9 to 1. No such increase was observed in the case of β-bromocamphor, or of compounds in which both the α- and α′-hydrogen atoms were displaced. The increase of solubility is ascribed to the formation in the solution of a small proportion (7 to 12 per cent.) of the stereoisomeric α′-compound (compare Kipping, Proc., 1905, **21**, 124 and 125).

***46. "The coagulating action of colloids. Part I." By William Porter Dreaper and Alexander Wilson.**

The addition of tannic acid to an organic colloid like gelatin or albumin in the hydrosol state determines the amount of gallic acid absorbed by the coagulum. The gallic acid may be present before or after the addition of tannic acid. Acids like hydrochloric or acetic reduce this absorption. Salts, on the other hand, increase it. These acids do not seem to replace the gallic acid by mass action or otherwise.

Gelatin in the hydrogel state absorbs gallic acid, although no precipitation takes place if the former is in the hydrosol state. Salts increase absorption, but alcohol reduces it.

Albumin absorbs gallic acid when precipitated by either tannic acid or heat. Alcohol prevents this action and also the absorption of tannic acid by albumin. Addition of gallic acid to a "solution" containing tannic acid and albumin causes rapid coagulation. This reaction is dependent on concentration. In very concentrated solutions, gallic acid will precipitate albumin.

Absorption by silk is greatly reduced in presence of alcohol, the tannic acid absorbed is reduced from 15 to 1·2 per cent. Hide powder behaves in a similar way, the tannic acid absorbed being reduced from 72 to 10 per cent.

Solutions of gelatin, "collin," and albumin give these reactions.

The results obtained by the author throw further light on dyeing and tanning processes. The influence of gallic acid in the manufacture of leather seems to be of a more direct nature than was previously supposed.

Discussion.

Mr. Dreaper, in reply to questions from Dr. Cain, stated that "collin" was a form of soluble gelatin used by Parker and Payne in the estimation of tannic acid; it did not enter the hydrogel state at the ordinary temperature.

The tannic and gallic acids were estimated by the process he had suggested some time ago. The tannic acid was titrated with copper sulphate solution in the presence of calcium carbonate. The separation of the two acids was brought about by precipitating the former as lead tannate in the presence of a definite excess of acetic acid, which prevented the gallate being precipitated at the same time. The gallic acid in the filtrate was then estimated as copper salt.

***47. "Studies on optically active carbimides. III. The resolution of α-phenyl-α′-4-hydroxyphenylethane by means of *l*-menthylcarbimide." By Robert Howson Pickard and William Oswald Littlebury.**

A method of resolving racemic hydroxyl compounds by means of *l*-menthylcarbimide was described. The *l*-menthylcarbamates thus obtained by the combination of these compounds can be separated by fractional crystallisation and are then hydrolysed by alcoholic sodium hydroxide. d-α-*Phenyl*-α′-4-*hydroxyphenylethane* l-*menthylcarbamate* separates in a pure condition from light petroleum and melts at 117°. When hydrolysed, it yields d-α-*phenyl*-α′-4-*hydroxyphenylethane*, which melts at 64° and has $[\alpha]_D$ +7·78° in benzene.

Discussion.

Dr. A. McKenzie asked whether the authors had obtained any evidence of the partial resolution of an inactive phenol into its optical isomerides by the action of an amount of *l*-menthylcarbimide insufficient for complete interaction. A partial resolution might be expected to occur under such conditions if the velocity of interaction of the *d*-phenol with the *l*-carbimide were different from that of the *l*-phenol. That an inactive alcohol may be partially resolved into its optical isomerides has been shown with *sec*-octyl alcohol (*Ber.*, 1901, **34**, 474).

It would be interesting to know whether the temperature conditions under which the fractional crystallisation described by the authors took place had much influence on the progress of the resolution.

Dr. Pickard, in reply to a question from Dr. Forster, stated that

the method of obtaining carbimides by the action of nitrous acid on the corresponding carbamides could not be used for the preparation of *l*-menthylcarbimide, as this reacts too readily with water.

In reply to Dr. McKenzie, he said that in attempting the resolution of *a*-phenyl-*a'*-4-hydroxyphenylethane by treatment with half its equivalent of *l*-menthylcarbimide, some experimental difficulties supervened and led to the adoption of the easier method of fractionally crystallising a mixture of the two modifications of the *l*-menthylcarbamates. No evidence of a transition temperature was observed during the investigation.

***48. "Experiments on the synthesis of the terpenes. Part VIII. Synthesis of the optically active modifications of Δ^{3}-*p*-menthenol(8) and $\Delta^{3:8(9)}$-*p*-menthadiene." By Francis William Kay and William Henry Perkin, jun.**

The terpenes and their derivatives, which have so far been obtained synthetically (*Trans.*, 1904, **85**, 654; 1905, **87**, 639, 655, 661, 1067, and 1083; Proc., 1905, **21**, 255), have always been inactive, but the following optically active members belonging to this group have now been synthesised.

Δ^{1}-*Tetrahydro*-p-*toluic acid*, $CHMe\langle\begin{matrix}CH_2-CH\\CH_2\cdot CH_2\end{matrix}\rangle C\cdot CO_2H$, contains an asymmetric carbon atom, and by the systematic crystallisation of its brucine and strychnine salts the authors have resolved it into its dextro- and lævo-modifications. The lævo-modification obtained from the brucine salt has a rotation of $[\alpha]_D$ $-100°$, whereas the dextro-acid obtained from the strychnine salt has a corresponding rotation of $[\alpha]_D$ $+101°$.

The esters of these acids were prepared by the action of alcoholic sulphuric acid; *ethyl* d-Δ^{1}-*tetrahydro*-p-*toluate* boiled at 154°/100 mm. and had $[\alpha]_D$ $+86°$, the lævo-modification boiled at 154°/100 mm. and had $[\alpha]_D$ $-84°$. On treating the latter with the theoretical amount of magnesium methyl iodide and then decomposing with water and dilute acid, l-Δ^{3}-p-*menthenol*(8), $CHMe\langle\begin{matrix}CH_2-CH\\CH_2\cdot CH_2\end{matrix}\rangle C\cdot CMe_2\cdot OH$, was obtained; this substance boils at 101°/14 mm. and has $[\alpha]_D$ $-67°$. When this menthenol is digested with potassium hydrogen sulphate, partial racemisation takes place, and the resulting $\Delta^{3:8(9)}$-p-*menthadiene*, $CHMe\langle\begin{matrix}CH_2-CH\\CH_2\cdot CH_2\end{matrix}\rangle C\cdot C\langle\begin{matrix}CH_2\\CH_3\end{matrix}$, which distils at 185°/748 mm., has a rotation $[\alpha]_D$ of only $-10°$.

Pure d-$\Delta^{3:8(9)}$-p-*menthadiene* was, however, obtained by the direct action of excess of magnesium methyl iodide on the *d*-ester without

the aid of the acid sulphate; it boils at 184—186°/756 mm. and has $[\alpha]_D$ +98°. The magnetic rotations and other physical constants of these interesting substances are being determined.

***49. "Studies in the acridine series. III. The methylation of chrysaniline." By Albert Ernest Dunstan and John Theodore Hewitt.**

The authors have continued the research on the lines laid down by Hewitt and Fox (*Trans.*, 1904, **85**, 529, and 1905, **87**, 1058), and have prepared the diacetyl and tetra-acetyl derivatives of chrysaniline, starting from the purified base.

By treatment with methyl iodide and methyl alcohol, the diacetyl derivative afforded an acridinium methiodide, which on hydrolysis immediately gave an anhydro-base; this substance was also prepared by the use of methyl sulphate and subsequent hydrolysis and precipitation with ammonia.

50. "Note on the application of the electrolytic method to the estimation of arsenic in wall-papers, fabrics, &c." By Thomas Edward Thorpe.

Known quantities of the material, as a rule about 2 grams, are moistened with lime water, mixed with calcined magnesia, dried, and charred. The ash is treated with dilute sulphuric acid, half a gram of potassium metabisulphite added, the solution boiled and diluted to a definite volume, and the whole or an aliquot portion, depending on the amount of arsenic suspected to be present, is added to the electrolytic arrangement already described (*Trans.*, 1903, **83**, 974). The deposit of arsenic so obtained is then compared with deposits obtained in precisely the same way by the addition of known quantities of arsenic, ranging from 0·005 to 0·0125 milligram of arsenious oxide, to materials free from arsenic, as in the method of testing brewing materials for arsenic already described (*loc. cit.*). A single incineration of the suspected material suffices for several tests. The amounts of lime-water and magnesia recommended to be used have been proved by direct experiment to retain amounts of arsenic ranging from 0·0025 to 5 milligrams when contained in 2 grams of wool or paper.

Many samples of woollen materials met with in commerce contain very notable quantities of arsenic, arising probably from the widespread use of arsenical dips.

51. "Nitrogen halides from camphoryl-ψ-carbamide." By Martin Onslow Forster and Hans Grossmann.

The action of potassium hypobromite and hypochlorite on camphoryl-ψ-carbamide has been found to give rise to dihalogen derivatives which have all the properties of compounds containing halogen attached to nitrogen. Normal camphorylcarbamide yields the same substances, owing to the readiness with which it changes into the *pseudo*-modification under the influence of alkalis. Corresponding monohalogen derivatives have been obtained from camphorylmethyl-ψ-carbamide and its normal modification.

52. "The relation of position isomerism to optical activity. VI. The rotation of the menthyl esters of the isomeric chloronitrobenzoic acids." By Julius Berend Cohen and Henry Percy Armes.

It was pointed out in a previous paper on this subject (*Trans.*, 1905, **87**, 1192) that whereas chlorine and bromine atoms in the ortho-position to the active group lower its rotation, the nitro-group has the opposite effect of greatly increasing it. In the present investigation, the combined effect of halogen and nitro-group on the activity of the menthyl group has been examined. The authors have studied the rotations of eight out of the ten isomeric chloronitrobenzoic esters, the 2-chloro-3-nitro- and 3-chloro-2-nitro-compounds being omitted owing to difficulties of preparation.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Löb, *Walther*. Electrochemistry of organic compounds. Authorised translation from the 3rd edition by *H. W. F.* **Lorenz**. pp. x + 308. ill. New York 1906. (*Recd.* 28/2/06.)
From the Publishers: Messrs. Wiley & Sons.

Stas, *Jean Servais*. Untersuchungen über die Gesetze der chemischen Proportionen, über die Atomgewichte und ihre gegenseitigen Verhältnisse. Uebersetzt von *L.* **Aronstein**. pp. xii + 347. Leipzig 1867. (*Recd.* 15/2/06.) From Dr. A. Scott, F.R.S.

II. *By Purchase.*

Low, *Albert H.* Technical methods of ore analysis. pp. x + 273. ill. New York 1905. (*Recd.* 20/2/06.)

ANNUAL GENERAL MEETING.

The Annual General Meeting of the Society for the election of Officers and Council and other business will be held on **Friday, 30th March, 1906, at 5 o'clock** in the afternoon.

The PRESIDENT will deliver his address entitled: "The living organism as a chemical agency: A review of some of the problems of photosynthesis by growing plants."

At the next Ordinary Meeting, on **Thursday**, March **15th**, 1906, at **8.30** p.m., the following papers will be communicated:

"The interaction of well-dried mixtures of hydrocarbons and oxygen." By W. A. Bone and G. W. Andrew.

"The explosive combustion of hydrocarbons." By W. A. Bone and J. Drugman.

"The occurrence of marsh gas amongst the decomposition products of certain nitrogenous bases as a source of error in the determination of nitrogen by the absolute method." By P. Haas.

"Studies on comparative cryoscopy. Part IV. The hydrocarbons and their halogen derivatives in phenol solution." By P. W. Robertson.

"The displacement of acid radicles. I. Displacement of the chloride and nitrate radicles." By A. F. Joseph.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. **No. 307.**

Thursday, March 15th, 1906, at 8.30 p.m., Professor R. MELDOLA, F.R.S., President, in the Chair.

Messrs. S. L. Courtauld, L. H. Durrans, and R. W. L. Clarke were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs :

Ernest Barrett, B.Sc., 56, Elswick Road, Lewisham, S.E.
Percy Garratt Chamberlain, M.A., 3, Market Place, Rugby.
Cecil Wyatt-Edgell, B.A., Cowrey Place, Exeter.
O. Bertram Foy, 16, Burlington Road, Dublin.
John Adam Watson, 8, Powis Gardens, Notting Hill, W.

A certificate has been authorised by the Council for presentation for ballot under Bye-Law I (3) in favour of :

Ram Chandra Mukerjee, B.A., of Jaipur, Rajputana, India.

The PRESIDENT announced that Dr. G. T. Morgan had found it necessary to resign the Editorship of the Society's publications, and the Council had appointed Dr. J. C. Cain to succeed him.

Attention was drawn to the fact that the Sixth International Congress of Applied Chemistry will be held in Rome, beginning on April 25th, 1906.

Of the following papers, those marked * were read:

***53. "The interaction of well-dried mixtures of hydrocarbons and oxygen." By William Arthur Bone and George William Andrew.**

The results of experiments carried out chiefly with mixtures of ethylene and oxygen, well dried by previous long contact with redistilled phosphoric oxide, do not support the view that the presence of steam is essential to the combustion of a hydrocarbon. It was shown that an amount of desiccation which almost inhibits the combination of hydrogen and oxygen (electrolytic gas) at 525° does not appreciably retard the oxidation of ethylene. The authors therefore conclude that oxygen is directly active in hydrocarbon combustion.

***54. "The explosive combustion of hydrocarbons." By William Arthur Bone and Julien Drugman.**

The authors showed, as the result of an exhaustive study of the explosive combustion of a number of different gaseous hydrocarbons, including paraffins up to butane and olefines such as ethylene, propylene, and the butylenes, that the theory of the preferential combustion of carbon completely breaks down when applied to hydrocarbon flames. The results of the research constitute a strong argument in favour of the view that there is no essential difference between the slow and rapid combustion of a hydrocarbon, and that explosive combustion probably involves the initial formation of unstable hydroxylated molecules, which subsequently undergo thermal decomposition into simpler products. Very striking differences as regards the composition of the end-products are obtained when explosive combustion occurs in the system $C_xH_y + x/2O_2$, according as the hydrocarbon is a paraffin or an olefine. In the case of a paraffin, there is always a separation of carbon and a large formation of steam, whereas in the case of the corresponding olefine there is no separation of carbon, and the cooled products consist almost entirely of carbon monoxide and hydrogen in accordance with the empirical equation $C_nH_{2n} + n/2O_2 = nCO + nH_2$. In the case of an olefine, it was shown that on reducing the proportion of oxygen much below that indicated by the expression $C_nH_{2n} + n/2O_2$, not only does carbon separate in the flame, but also a large formation of steam occurs, a result which is quite incompatible with the theory of the preferential combustion of carbon in hydrocarbon flames.

Comparative experiments on the explosion of mixtures correspond-

ing to $C_2H_6+O_2$, $C_2H_4+H_2+O_2$, and $C_2H_2+2H_2+O_2$ respectively prove that the process cannot be regarded as involving the primary dissolution of the hydrocarbon, followed by a distribution of the oxygen between free carbon and hydrogen.

Incidentally, it was shown that the affinity of hydrocarbons for oxygen at high temperatures is enormously greater than that of hydrogen, so that whenever mixtures of hydrocarbons and hydrogen react with a supply of oxygen less than is required to complete the initial combustion stages of the hydrocarbon, the latter is burnt almost to the entire exclusion of the hydrogen. Hence, in hydrocarbon flames, the initial stages of the oxidation of the hydrocarbon probably take precedence of all other chemical processes.

Discussion.

Professor Smithells said that he was very ready to confess any mistake he might have made in giving currency to the idea of a "preferential oxidation" of carbon in the combustion of hydrocarbons. He admitted at once that the expression was not universally applicable, and he would endeavour in future not to use it without the necessary qualifications. He wished, however, to remind Fellows what the history of the matter really was. When he began to experiment with flames, he was under the conviction, which he believed was shared by chemists in general, that when a hydrocarbon was burned with a restricted supply of oxygen, carbon rather than hydrogen would remain unoxidised. That view lay at the root of the explanation of the luminosity of hydrocarbon flames then current. When, experimenting with the aërated flame of ethylene, he had found that the interconal gases contained a large quantity of free hydrogen and no unoxidised carbon, and when he had found this to be true of hydrocarbon flames in general, he felt that a complete revolution must be made in our views, and it was then that he used the expression preferential combustion of carbon. In describing chemical changes, it was customary to name the substances used and the substances ultimately obtained. Whatever transitory products might be formed, however the mechanism might be regarded, it was the custom to say, for example, that zinc and strong sulphuric acid give sulphur dioxide, zinc sulphate, and water. We might suppose that zinc first displaced hydrogen from the acid and that the hydrogen reduced some more of the acid, or that the zinc was oxidised by the acid and the oxide then dissolved in more acid. Then, again, hydrogen sulphide and free sulphur were to some extent formed. In such an apparently simple reaction as this, we could affirm nothing with certainty about the actual mechanism. Therefore, we said simply that zinc and sulphuric

acid give sulphur dioxide, water, and zinc sulphate. In like manner, it might be said that in the case of hydrocarbon flames burning with a restricted supply of oxygen the carbon was preferentially oxidised.

With regard to the probable course of the oxidation, he considered that Dr. Bone had made out a very strong case. It was undoubtedly possible that all the stages which the author had indicated might be passed through; he did not think the explanation presented great difficulties from the standpoint of the kinetic theory of gases. On the other hand, it was undoubtedly possible that the final condition of equilibrium might be reached in one bound, just as a stone under impulse might reach the foot of a hill in one bound instead of following the contour of the slope. It was a question of the balance of evidence. The most serious piece of experimental evidence he knew against Dr. Bone's view was that in those parts of a flame where the partial combustion of hydrocarbons is taking place there is to be seen a spectrum which he believed to be only known where carbon and oxygen were uniting to form carbon monoxide. That spoke for a direct attack of the oxygen on the carbon. The solution of the question was one of extreme difficulty, and, as he had said, it involved the careful weighing of circumstantial evidence.

Having dealt, Dr. ARMSTRONG said, with Dr. Bone's work elsewhere, and being in agreement with him on the main issue, there were but few matters to which he need refer. One of the most striking points brought before them was the incombustibility of hydrogen as compared with hydrocarbons—he thought that it would have to be recognised that hydrogen was not the active, attractive element it was commonly supposed to be in hydrogen compounds, but that more often than not it simply became pushed aside, as it were. The carbon appeared to be primarily the attractive element, and in this restricted sense Professor Smithells was justified in speaking of the preferential combustion of the carbon in hydrocarbons. As to the influence of moisture on the combustion of hydrocarbons, it was to be expected that a hydrocarbon-oxygen mixture would be much more sensitive to change than one of hydrogen and oxygen. Such questions *must* be regarded from the point of view of some consistent theory of chemical change; it would be very difficult to obtain direct experimental proof that conducting water was essential to the occurrence of the combustion. The view he had expressed twenty years ago in that room, that a mixture of hydrogen and oxygen alone would be found to be incombustible, was now accepted, however, and he did not hesitate to assert that it was necessary to extend the argument from hydrogen to hydrocarbons but would not be surprised if another twenty years passed before it were recognised that a mixture consisting simply of a hydrocarbon and oxygen was incombustible.

Dr. BONE, in reply, remarked that the discussion had not elicited any definite criticism of the views he had advanced in the paper. His own position was simply this. In conjunction with Dr. Drugman, he had discovered certain facts which proved that preferential combustion of carbon did not take place in hydrocarbon flames, but which could be perfectly well explained on the supposition that hydroxylated or oxygenated molecules were initially formed. He had endeavoured to form a mental picture of the processes going on in the flame, but, beyond expressing the conviction that the oxygen is in some way actually incorporated with the hydrocarbon before the system breaks down into simpler products, he did not wish to put forward any theory otherwise than as a working hypothesis.

***55. "The occurrence of methane amongst the decomposition products of certain nitrogenous bases as a source of error in the estimation of nitrogen by the absolute method." By Paul Haas.**

The gas collected over caustic potash in a Schiff's nitrometer during the estimation of nitrogen by the absolute method was found in the case of more than twelve different compounds to contain methane. The accumulation of this gas was prevented by replacing the copper oxide ordinarily used in such analyses by lead chromate, which effectually oxidises any methane formed.

DISCUSSION.

Mr. CARR remarked that the different results obtained when the base or its hydrochloride are burnt and the inhibitive influence of cuprous chloride confirmed the results obtained by Prof. Dunstan and himself. These experiments had shown that methane can only be burnt with great difficulty by passing it over strongly heated copper oxide. From the evidence now adduced he thought that the use of cuprous chloride in determinations of nitrogen by the absolute method should become general. More methane is obtained by the "carbon dioxide" method than by Frankland and Armstrong's vacuum method.

Mr. W. A. DAVIS stated that in 1896, shortly after the publication of Prof. Dunstan and Mr. Carr's results, he had found that 1-nitro-2-methoxynaphthalene gave abnormally high results for nitrogen estimated by the absolute method and that the "nitrogen" collected was inflammable. The numbers obtained with the substance agreed closely with those required for a dinitro-derivative, but the fact that normal results were obtained with the derived 1-amino- and 1-acetylamino-2-methoxynaphthalene clearly established the true nature of the compound. It was doubtful whether the formation of methane could be attributed to any special structure, but it seemed, under exceptional conditions, to be associated with the presence of a methyl or methoxyl group.

Dr. Bone said that, with regard to combustions over a hot surface of copper oxide, he had found that the rate of disappearance of hydrogen when electrolytic gas, $2H_2+O_2$, was circulated over copper oxide at 200° was only about 1/30th of the corresponding rate when a mixture of $2H_2+N_2$ was employed. The oxygen in the electrolytic gas was condensed on the hot surface, forming a film which actually protected the copper oxide from the reducing action of hydrogen. Possibly other gases would be similarly condensed on the surface. He was not at all sure that the usual practice of using oxygen instead of air in ordinary combustion analyses over copper oxide was a good one.

56. "Studies on comparative cryoscopy. Part IV. The hydrocarbons and their halogen derivatives in phenol solution." By Philip Wilfred Robertson.

The hydrocarbons and their halogen derivatives are characterised by the fact that they give low molecular depressions, which decrease slowly with the concentration. This phenomenon appears to be intimately connected with the association of the solvent, as it is not exhibited to the same extent by the less associated substituted phenols, *o*-cresol, thymol, guaiacol, and *o*-nitrophenol.

It is also shown that benzene does not differ in behaviour from the other hydrocarbons examined, and hence its low molecular depression cannot be attributed to the formation of a solid solution, as Bruni endeavours to prove (*Gazzetta*, 1898, **28**, i, 249). By employing van Bijlerts' method, his results show that the benzene forms a 30 per cent. solid solution in the phenol. From this it is concluded that van Bijlerts' method is not always trustworthy, and, moreover, it is not justifiable to assume the existence of a solid solution when the observed molecular depression differs only slightly from the theoretical.

57. "The displacement of acid ions. Part I." By Alfred Francis Joseph.

The author described his investigations on the quantitative action of hydrochloric acid on the nitrates of potassium, sodium, and strontium, and of nitric acid on the corresponding chlorides. An equivalent of the salt in aqueous solution is mixed with x equivalents of the acid, the mixture evaporated to dryness on the water-bath, and the proportion of chloride in the residue determined by titration with standard silver nitrate solution.

If the quantity of salt transformed be y, then it is found that the

equation $y = a\log_{10}x + b$ holds good over a considerable range of values of x, a and b being constants depending on the particular acid and salt used. These constants increase and decrease simultaneously with the ratio of the solubilities of the two salts concerned in the transformation. It was found that to transform half the nitrate into chloride by one evaporation with hydrochloric acid requires about 1·5 equivalents of acid in the case of sodium nitrate, 2·9 for potassium nitrate, and 12 for strontium nitrate.

On the other hand, to transform nine-tenths of the chloride into nitrate requires 1·6 equivalents of nitric acid in the case of sodium chloride, 1·4 for potassium chloride, and 1·05 for strontium chloride.

58. "Additive compounds of arylamines with aromatic nitro-derivatives." * By Charles Loring Jackson and Latham Clarke.

The following additive compounds have been prepared by the authors in addition to those already described (*Ber.*, 1904, **37**, 176).

4 : 6-*Dibromo*-1 : 3-*dinitrobenzene dimethylaniline*,

$$2C_6H_2Br_2(NO_2)_2,C_6H_5\cdot NMe_2,$$

which is precipitated as a heavy, red oil. When alcohol is added to a solution of the nitro-compound in an excess of dimethylaniline, it quickly solidifies to short, deep red prisms melting at 50°.

0·3487 gave 0·3373 AgBr. Br = 41·12.
0·1762 „ 0·1705 AgBr. Br = 41·16.
$C_{20}H_{15}O_8N_5Br_4$ requires 41·39 per cent.

The compound is extremely unstable and readily loses dimethylaniline when exposed to the air.

4-*Chloro*-1 : 3 : 5-*tribromo*-2 : 6-*dinitrobenzene dimethylaniline*,

$$C_6ClBr_3(NO_2)_2,2C_6H_5\cdot NMe_2,$$

obtained in the same way as the preceding compound, crystallises in slender, yellow needles and melts at 105°.

0·086 gave 0·0889 AgCl and AgBr; Cl + Br = 40·25.
$C_{20}H_{11}O_8N_5Cl_2Br_6$ requires Cl + Br = 40·43 per cent.

The following compounds give red colorations with dimethylaniline; in certain cases the colour is removed by the addition of solvents, and in no case has a definite crystalline additive compound been isolated. Nitrobenzene, α-nitronaphthalene, *o*-nitrophenol, *m*-dinitrobenzene, 4-bromo-1 : 3-dinitrobenzene, 4 : 6-di-iodo-1 : 3-dinitrobenzene, 1 : 3 : 5-tri-

* The investigations on additive compounds of trinitrobenzene with amines formerly described (*Ber.*, 1904, **37**, 176) and in this paper were undertaken before a copy of J. J. Sudborough's second paper (*Trans.*, 1903, **83**, 1334) had been received by the authors, who thereupon discontinued their experiments.

chloro-2 : 4-dinitrobenzene, 4-bromo-3 : 5-dinitrobenzoic acid (which yields a salt melting at 120—125°), 4-ethoxy-3 : 5-dinitrobenzoic acid, 4-*iso*amyloxy-3 : 5-dinitrobenzoic acid, and picric acid.

Methylaniline and *s*-trichlorotrinitrobenzene yield an unstable ***additive compound***, which crystallises in red plates melting at about 78°; it becomes colourless when exposed to the air or when washed with ether, chloroform, or acids.

Several of the compounds of toluidines with trinitrobenzene and trinitrotoluene have been prepared (compare Hepp, *Annalen*, 1882, **215**, 344; Noelting and Sommerhoff, *Ber.*, 1906, **39**, 76). The compounds with trinitrotoluene are much less stable than those with trinitrobenzene.

The ***additive compound*** of *p*-toluidine and trinitrotoluene, which Sommerhoff could not obtain, may be prepared by fusing a mixture of the two components, adding a very small amount of toluene, and allowing to cool; it crystallises in dark red needles melting at about 68°.

0·2845 gave 41·4 c.c. of moist nitrogen at 20° and 768 mm. N = 16·82.

$C_{14}H_{14}O_6N_4$ requires N = 16·76 per cent.

s-Trichlorotrinitrobenzene and pyridine form an extremely unstable ***additive compound***, $C_6Cl_3(NO_2)_3,C_6H_5N$, which crystallises in slender, red crystals.

0·1232 gave 0·1224 AgCl. Cl = 24·56. $C_{11}H_5O_6N_4Cl_3$ requires 26·87 per cent.

When kept for a short time, this substance sets to a black resin.

59. "Influence of substituents in the trinitrobenzene molecule on the formation of additive compounds with arylamines." By John Joseph Sudborough and Norman Picton.

The formation of additive compounds between *α*- or *β*-naphthylamine and *s*-trinitrobenzene derivatives is completely inhibited by the introduction of three methyl-, two methoxy-, or three bromo-radicles into the trinitrobenzene molecule. *s*-Trichlorotrinitrobenzene, however, is still capable of combining with *α*-naphthylamine. Various additive compounds are described.

The compounds derived from the naphthylamines and chloro-derivatives of the di- and tri-nitrobenzenes readily lose hydrogen chloride, yielding condensation products of the type of picryl-*β*-naphthylamine, $C_6H_2(NO_2)_3{\cdot}NH{\cdot}C_{10}H_7$. Several compounds of this type have been examined and the following points established: (1) most of the compounds exist in two distinct modifications, namely, a sulphur-yellow and a bright red variety. These may be mutually transformed

one into the other by simple methods. (2) They form monopotassium salts which are readily hydrolysed by water. (3) They do not yield acetyl derivatives. (4) Some form extremely unstable additive compounds with arylamines. (5) It has not been found possible to replace the one arylamino-group, $\cdot NH \cdot C_6H_5$ for example, by another, such as $\cdot NH \cdot C_{10}H_7$.

60. "The relations between absorption spectra and chemical constitution. Part IV. The reactivity of the substituted quinones." By Alfred Walter Stewart and Edward Charles Cyril Baly.

The reactive power of carbonyl groups in quinones has been shown by Kehrmann (*Ber.*, 1888, **21**, 3315; *J. pr. Chem.*, 1889, [ii], **39**, 399; **40**, 257) to be greatly influenced by the replacement of the hydrogen atoms of the quinone nucleus by methyl radicles or halogen atoms. This has hitherto been explained on the assumption that such substituents sterically hinder the reactions of the carbonyl group in the ortho-position to which they lie. It appeared to the authors that a better explanation might be found in the influence of the substituents on the isorropic process in which the quinone carbonyls are concerned.

An examination was made of the absorption spectra of the following quinones: *p*-benzoquinone, toluquinone, *p*-xyloquinone, thymoquinone, chlorobenzoquinone, bromobenzoquinone, 2 : 6-dichlorobenzoquinone, trichlorobenzoquinone, trichlorotoluquinone, dibromothymoquinone, and dichlorothymoquinone; and from these spectra the following facts may be deduced. (1) Benzoquinone has an isorropic band of long persistence, and shows no sign of benzenoid structure; (2) the introduction of methyl radicles or of halogen atoms tends to diminish the persistence of the isorropic band and to produce in the spectrum a benzenoid band, the change being greater with chlorine than with methyl; (3) the benzenoid character of the compound is intensified in proportion to the decrease in the isorropic band.

From these facts the following conclusions may be drawn. Benzoquinone exists almost entirely in the quinonoid form. Toluquinone, while existing to a great extent in the quinonoid form, possesses certain characteristics of benzene and probably vibrates in a manner similar to that in which the benzene molecule oscillates. Chlorobenzoquinone, although still possessing certain quinonoid properties, is in a state of vibration approximating more closely to the intramolecular motions of benzene. Trichlorobenzoquinone, in which the isorropic process is practically non-existent, vibrates in a manner closely resembling the vibrations of the benzene ring.

Now Kehrmann has shown that the introduction of methyl radicles or halogen atoms hinders the formation of quinoneoximes, and the amount of hindrance observed by him is in complete accord with the change in character from the quinonoid to the benzenoid type which is proved by the spectroscopic evidence. In their previous papers (this vol., p. 33), the authors showed that in order to bring about the isorropic process the quinonoid structure had first to be produced. As the reactivity of the carbonyl group depends on the isorropic process, it is evident that the benzenoid character of the compounds examined is alone sufficient to explain their non-reactivity, without introducing the question of a purely hypothetical "steric hindrance." The facts now submitted, in conjunction with those already communicated to the Society, tend to show that there is no necessity for the assumption of any such purely mechanical causes underlying the hindrance to chemical reactions.

61. "The constitution and properties of acyl thiocyanates."
By John Hawthorne.

It has been shown (Dixon and Hawthorne, *Trans.*, 1905, **87**, 468) that when acetyl "thiocyanate" interacts with aniline, two changes occur simultaneously: (1) double decomposition, the sulphur appearing as thiocyanic acid, $AcSCN + PhNH_2 = HSCN + AcNHPh$; (2) addition, the sulphur now exhibiting thiocarbimidic functions, $AcNCS + PhNH_2 = AcNH{\cdot}CS{\cdot}NHPh$. At low temperatures the former reaction predominates, and at high temperatures the latter.

It has now been shown that, besides temperature, two other factors may have an influence on the course of the interaction between an acyl "thiocyanate" and a base: (1) the nature of the base presented, and (2) the nature of the acidic radicle of the "thiocyanate." The results are recorded of experiments made at various temperatures on the systems *o*-toluidine—acetyl "thiocyanate" and aniline—propionyl "thiocyanate," from which it appears (1) that *o*-toluidine causes a great increase of the thiocarbimidic functions of acetyl "thiocyanate" as compared with aniline, and (2) that, towards aniline, acetyl and propionyl "thiocyanates" behave very nearly alike.

Since in all the above reactions acetyl "thiocyanate" behaves towards a given base as if it were a mixture of acetyl thiocyanate and acetylthiocarbimide in proportions depending on the temperature, a series of determinations of the molecular refraction of the pure substance was carried out. Within the limits of temperature examined, this value was practically constant, the mean, 45·9, as deduced from the formula $M = \frac{(\mu - 1)m}{d}$, being inconsistent with the

value required for a compound having the structure Ac·S·C:N, but agreeing closely with that corresponding to Ac·N:C:S.

62. "A mode of formation of aconitic and citrazinic acids and their alkyl derivatives, with remarks on the constitution of aconitic acid." By Harold Rogerson and Jocelyn Field Thorpe.

By the condensation of the sodium derivative of ethyl cyanoacetate with ethyl oxalacetate, ethyl α-cyanoaconitate,

$$CN\cdot CH(CO_2Et)\cdot C(CO_2Et):CH\cdot CO_2Et,$$

is produced. This ethyl salt on hydrolysis with acid hydrolysing agents is converted into aconitic acid, whilst with alkaline hydrolytic agents it is transformed into citrazinic acid. Alkyl derivatives of these compounds are formed when alkyl derivatives of ethyl α-cyanoaconitate, prepared either by the direct alkylation of this substance or by the condensation of the sodium derivative of ethyl cyanoacetate with alkyl derivatives of ethyl oxalacetate, are hydrolysed. It was shown that aconitic acid, like glutaconic acid, has a symmetrical structure, and that α-methylaconitic and γ-methylaconitic acids are tautomeric.

63. "Aromatic sulphonium bases." By Samuel Smiles and Robert Le Rossignol.

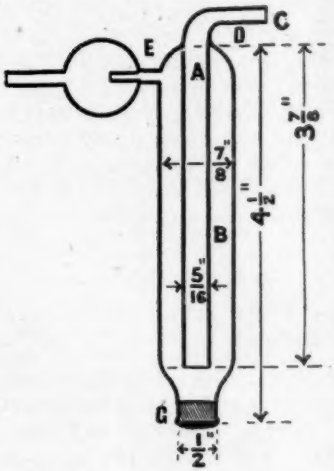
It was shown that the action of thionyl chloride on phenetole in presence of aluminium chloride gives rise to *p*-phenetylsulphoxide and triphenetylsulphonium chloride; the latter is produced by the action of excess of phenetole on the sulphoxide. This reaction has led to the discovery of two other methods of preparing these aromatic sulphonium bases: (1) from a sulphoxide and phenetole with a dehydrating agent; (2) from a sulphinic acid and phenetole with strong sulphuric acid. It is also shown that in this reaction a sulphoxide is formed as an intermediate product.

64. "A new form of calcium chloride tube for combustion." By Arthur Edwin Hill.

The calcium chloride tube indicated in section in the figure on p. 88 consists essentially of an inner exit tube, *A*, which is enclosed within a larger inlet tube, *B*, the latter being fused to the tube *A* at *D* and carrying a side-tube, *E*, provided with the usual form of bulb in which water can collect as liquid. The apparatus is easily filled by inverting it and pouring finely granulated calcium chloride into both the tubes *A* and *B*; before filling, a little glass wool should be inserted at the

top of both the inner and outer tubes and after charging with calcium chloride more glass wool is introduced; a suitable cork is then inserted at *G*; finally, this cork is cut off flush with the bottom of the tube and neatly covered with sealing wax.

The bulk of the water produced in the combustion is condensed in the bulb on the tube *E*, the remainder being absorbed during the passage of the moist gases down *B* and up *A*. A double scrubbing action is thus obtained by the aid of a comparatively small weight of calcium chloride; this, in fact, in addition to its compactness, is a special feature of the tube and the cause of its efficiency. A certain amount of free space, not packed with the chloride, in the tube *B*, immediately above the point of connection with *E*, is allowed, into which the water vapour can diffuse before coming into contact with the calcium chloride; by this means, the calcium chloride is uniformly wetted.



The new form of tube presents a number of advantages:

(1) The double scrubbing action, which ensures complete desiccation by means of a comparatively small quantity of calcium chloride. The whole apparatus when filled weighs only from 25 to 30 grams.

(2) It can be very easily emptied and refilled. There are no tubes to be sealed off at the blow-pipe and only a single cork is required.

(3) It is very compact and strong, the bend which is a point of weakness in the ordinary U-tube being got rid of. It is also more easily manipulated than the ordinary form of tube.

(4) It can be more easily and rapidly wiped dry before weighing. Several analyses made for the purpose of testing the tube have shown that it gives perfectly satisfactory results. The carbon dioxide produced simultaneously with the water is easily and completely swept from the tube into the potash bulbs by the current of air usually employed in a combustion.

65. "The viscosity of liquid mixtures. Part III." By Albert Ernest Dunstan.

The author's previous work and his hypotheses regarding maximum and minimum points in viscosity.concentration curves were summarised and some relations between viscosity and molecular weight were indicated.

For liquid mixtures of unimolecular components, it was shown that the general viscosity curve is concave to the axis of percentage composition, owing to the reciprocal effect of each liquid on the other.

Moreover, the depression angles which measure these mutual effects are, in general, proportional to the molecular weight of the liquid concerned. The "external angle" lying between the curve and the viscosity axis is shown to be also proportional to the molecular weight of the liquid.

The formulæ proposed by Arrhenius was discussed, and it was pointed out that no formula can interpret the curves which does not contain a factor characteristic of each curve. Each allied substance lies on a simple parabolic curve. The curves connecting molecular weight with the $\log_{10}$ viscosities are straight lines. The associated lower members of each group diverge somewhat from this line. Water, and formic and acetic acids show anomalous behaviour. If the family to which any liquid belongs is known, the molecular weight of the liquid can be calculated.

66. "The action of phenylpropiolyl chloride on the ketonic compounds. Part II." By Siegfried Ruhemann.

The compounds previously described by Ruhemann and Merriman (*Trans.*, 1905, **87**, 1383) have been subjected to a closer investigation. The red compound $C_{14}H_{12}O_3$, which was represented by the formula $\begin{matrix}C(C_6H_5)\cdot C(CH_3)\\ C(OH)\text{———}CO\end{matrix}\!\!>\!C\cdot CO\cdot CH_3$, reacts with phenylhydrazine to yield a phenylhydrazone which, on account of its insolubility in alkali, is considered to have the constitution

$$C_6H_5\cdot NH\cdot N{:}C\!<\!\begin{matrix}CH(C_6H_5)\text{———}\\ CO\cdot C(CO\cdot CH_3)\end{matrix}\!\!>\!C\cdot CH_3.$$

Its formation, therefore, is accompanied by the change of the enolic into the ketonic group. Analogous formulæ should be attributed to the semicarbazone, $C_{15}H_{15}O_3N_3$, and the oxime, $C_{14}H_{13}O_3N$. The fact that these two compounds are colourless indicates that the colour of the red compound $C_{14}H_{12}O_3$ is due to the grouping $-CO\cdot COH{:}C<$ and disappears with the change into $\begin{matrix}HC\\ |\\ CO\end{matrix}\cdot CO\cdot CO-$. The former configura-

tion yields blue salts with alkalis. The results thus obtained are used to establish the structural formulæ of the derivatives of oxalyldibenzylketone (see Claisen and Ewan, *Annalen*, 1895, **284**, 245), the properties of which resemble the red substance $C_{14}H_{12}O_3$. The former compound with alkalis yields both blue salts and yellow salts. The blue salts owe their formation to the same arrangement of the ketonic and enolic groupings as is contained in the red substance $C_{14}H_{12}O_3$, whilst in the yellow salts the ketonic group occupies the β-position with respect to the enolic group.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Caven, *Robert Martin*, and **Lander**, *George Druce*. Systematic inorganic chemistry from the standpoint of the periodic law. pp. xix + 374. London 1906. (*Recd.* 2/3/06.) From the Authors.

Liebreich, *Oscar*. Third treatise on the effects of borax and boric acid on the human system. Being a critical review of the report of *Dr. H. W.* **Wiley**, Chief of the Bureau of Chemistry of the U.S. Department of Agriculture, to the Secretary of Agriculture. Translated from the German. With diagrams. pp. vii + 70. London 1906. (*Recd.* 9/3/06.) From the Publishers: Messrs. J. & A. Churchill.

Metropolitan Water Board. Report on the results of the chemical and bacteriological examinations of the London waters, for the month ending November 30th, 1905, &c. By *A. C.* **Houston**. London 1905. From the Board.

Rolfe, *George William*. The polariscope in the chemical laboratory. An introduction to polarimetry and related methods. pp. vii + 320. ill. New York 1905. (*Recd.* 9/3/06.)
From the Publishers: The Macmillan Company.

Welch, *George Edward*. Chemistry lecture notes. pp. 63. London 1905. (*Recd.* 9/3/06.) From the Publishers: Messrs. Blackie & Son.

II. *By Purchase.*

Freund, *Ida*. The study of chemical composition. An account of its method and historical development. With illustrative quotations. pp. xvi + 650. ill. Cambridge 1904. (*Recd.* 3/3/06.)

Rutherford, *Ernest*. Radioactivity. pp. xiv + 580. Cambridge 1905. (*Recd.* 3/3/06.)

III. *Pamphlets.*

Day, *Arthur L.* Mineral solution and fusion under high temperatures and pressures. (From the *Year Book of the Carnegie Institution of Washington*, **4**, 1905.)

Paterson, *David.* Concerning indigo, natural and artificial. (From the *Oil and Colourman's Journal*, **28**, 1905.)

Schroeder, *August.* Beiträge zur Kenntnis einiger ausländischen Fette und Oele. pp. 67. Strassburg 1905.

Stapleton, *Henry Ernest.* Sal-ammoniac: a study in primitive chemistry. (From the *Memoirs, Asiatic Soc. Bengal*, 1, 1905.)

Stapleton, *Henry Ernest,* and **Azo,** *R. F.* Alchemical equipment in the eleventh century, A.D. (From the *Memoirs, Asiatic Soc. Bengal*, 1, 1905.)

Watts, *Francis,* and **Tempany,** *H.* The polarimetric determination of sucrose. (From the *West Indian Bulletin*, **6**, 1905.)

ANNUAL GENERAL MEETING.

The Annual General Meeting of the Society for the election of Officers and Council and other business will be held on **Friday, 30th March, 1906, at 5 o'clock** in the afternoon.

The PRESIDENT will deliver his address entitled: "The living organism as a chemical agency: A review of some of the problems of photosynthesis by growing plants."

At the next Ordinary Meeting, on **Thursday**, April **5th**, 1906, at **8.30** p.m., the following papers will be read:

"An improved apparatus for measuring magnetic rotations and obtaining a powerful sodium light." By W. H. Perkin, sen.

"The rusting of iron." By G. T. Moody.

"The determination of carbon in soils." By A. D. Hall, N. H. J. Miller, and N. Marmer.

"The electrolysis of the salts of $\beta\beta$-dimethylglutaric acid." By J. Walker and J. K. Wood.

"Bromo- and hydroxy-derivatives of $\beta\beta\beta'\beta'$-tetramethylsuberic acid." By J. K. Wood.

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Issued 12/4/06

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 308.

Friday, 30th March, 1906. Annual General Meeting, Professor R. MELDOLA, F.R.S., President, in the Chair.

Prof. J. J. SUDBOROUGH and Mr. J. L. BAKER were appointed Scrutators, and the Ballot was opened for the election of Officers and Council for the ensuing year.

The President presented the Report of the Council on the progress of the Society during the past twelve months. The adoption of the Report of the Council was proposed by Mr. R. J. FRISWELL, seconded by Dr. H. BRERETON BAKER, and carried unanimously.

REPORT OF THE COUNCIL.

THE Council have the satisfaction of being able to report that the past year has been a prosperous one for the Society, the activity of which, as measured by the number of papers read and the number of Fellows on the list, has exceeded that of any previous year.

On the 31st December, 1904, the number of Fellows was 2,711. During 1905, 164 Fellows were elected and 2 reinstated, thus making a gross total of 2,877. The Society has lost 25 Fellows by death, 28 have resigned, the election of 3 has become void, 1 has withdrawn, and 35 have been removed for non-payment of Annual Subscriptions. The total number of Fellows, therefore, on the 31st December, 1905, was 2,785, showing an increase of 74 over the number for the previous year.

The names of the deceased Fellows, with the dates of their election, are:

W. Ackroyd (1897).
C. M. Blades (1885).
J. F. Braga (1881).
G. B. Buckton (1852).
J. L. Bullock (1842).
C. F. Burnard (1849).
J. H. Calvert (1871).
H. S. Carpenter (1875).
J. Duncan (1863).
H. S. Elworthy (1886).
J. Epps (1885).
E. Graham (1895).
W. H. Greenwood (1873).
F. W. Harrold (1891).
F. M. Mercer (1884).
M. Prasad (1903).
A. B. Prescott (1876).
W. T. Rickard (1845).
R. Roose (1886).
F. Shapley (1893).
C. W. Sutton (1884).
C. R. C. Tichborne (1863).
L. White (1862).
W. W. Will (1885).
R. Yates (1874).

The following Fellows have resigned:

J. Ball.
S. Barlet.
G. E. P. Broderick.
C. J. Brooks.
A. J. Carrier.
F. E. Catchpole.
C. Childs.
C. G. Cresswell.
J. Dennant.
H. Goodier.
H. P. Harris.
J. H. Hichens.
S. Hill.
A. Houston.
C. Hunt.
J. T. Johnson.
H. W. Kinnersley.
W. Lang.
H. W. Lawrence.
F. H. Lescher.
W. H. Martin.
J. Percival.
W. S. Rowntree.
T. Samuel.
C. E. S. Sherratt.
W. J. Stainer.
G. R. Tweedie.
T. E. Vasey.

The small number of Fellows still living who were elected in the early days of the Society has been further reduced by the death of Mr. G. B. Buckton, who was elected in March, 1852, and of Mr. J. L. Bullock, elected in 1842. Since the close of 1905, the Society has had to lament the loss of Professor Hermann Johann Philipp Sprengel, who was elected in December, 1864.

The number of Honorary and Foreign Members at the date of the last Annual General Meeting was 35. No names have been added to the list since then, but the Society has sustained a loss in the death of Professor P. T. Cleve, who was elected in February, 1883, and who died on June 18th, 1905. The work of the deceased Honorary and Foreign Member is to be commemorated by a Memorial Lecture, the delivery of which has been undertaken by Professor T. E. Thorpe.

During the year 1905, 233 scientific communications have been

made to the Society, 191 of which have been published already in the *Transactions*, and abstracts of all have appeared in the *Proceedings*.

The volume of Transactions for 1905 contains 1,936 pages, of which 1,818 are occupied by 184 memoirs, the remaining 118 pages being devoted to the Wislicenus Memorial Lecture, the Obituary Notices, the Report of the Annual General Meeting, and the Presidential Address; the volume for the preceding year contains 175 memoirs, which occupy 1,715 pages.

The Journal for 1905 contains also 4,356 abstracts of papers published mainly in foreign journals, which extend to 1,828 pages, whilst the abstracts for 1904 numbered 4,617, and occupied 1,920 pages.

The abstracts for 1905 may be classified as follows:

Part I.

	Pages.	No. of Abstracts.
Organic Chemistry	956	1,727

Part II.

General and Physical Chemistry		619
Inorganic Chemistry.....		562
Mineralogical Chemistry		71
Physiological Chemistry		467
Chemistry of Vegetable Physiology and Agriculture		295
Analytical Chemistry		615
	872	2,629
Total in Parts I. and II.	1,828	4,356

In making comparison with the preceding year, it must be borne in mind that the 1904 volume contained the abstracts for thirteen months. Owing to the change in date of publication, no abstracts appeared between December 1st, 1903, and January 31st, 1904, so that the number of the Journal published on the latter date contained practically the abstracts of two months (see *Trans.*, 1905, 87, 539).

The Council regrets to announce that Dr. G. T. Morgan has found it necessary to resign the post of Editor of the Society's publications which he has occupied so creditably since the beginning of 1903. Although his resignation was received in September, 1905, Dr. Morgan kindly acted as Editor until the appointment of his successor, Dr. J. C. Cain.

The second part (Subject Index) of the Collective Index for the decade 1893–1902 was issued in December, 1905, to those Fellows who had made application for it in accordance with the printed notices circulated with the monthly parts of the Journal subsequently to July, 1903, and the Council have pleasure in expressing the high appreciation of the ceaseless energy displayed by the Indexer, Mrs. Margaret Dougal, on the completion of this valuable work.

During the vacation of 1905, advantage was taken of the Doctorial Jubilee of Professor Adolph von Baeyer, and of the Professorial Jubilee of Professor Mendeléeff, to address letters of congratulation to these two distinguished Honorary and Foreign Members.

In June, 1905, the Council decided that the Ordinary Meetings of the Society should be held during the ensuing Session on the first and third Thursdays of the month at 8.30 p.m. The experiment of holding the meetings on Wednesday afternoons at 5.30 p.m., alternately with Thursday evenings at 8 p.m., had been in operation since January, 1902, and from the fact that the average attendance of Fellows at the afternoon meetings had undergone steady diminution during this period, whilst the number of Fellows attending the evening meetings had increased, it has been concluded that a majority of the Fellows who make a practice of attending the meetings find the evening more convenient than the afternoon.

The Library has received an important addition by the generosity of Sir Henry E. Roscoe, who has presented to the Society a collection of 136 alchemical and early chemical works of great interest and value.

An increase in the use of the Library is recorded, 1,108 books being borrowed during 1905, as against 1,057 in the previous year. Additions to the Library, excluding Sir Henry Roscoe's donation, comprise 165 books, of which 58 were presented, 324 volumes of periodicals, and 48 pamphlets, as against 119 books, 296 volumes of periodicals, and 52 pamphlets last year. On the recommendation of the Library Committee the Council have made an addition to the Library Rules in the following terms: "No persons other than Fellows of the Society have the privilege of using the Library, except upon a written introduction from a Fellow, with whom rests the responsibility for all books consulted by the person introduced. Such introduction shall be valid for one occasion only."

Grants amounting in all to £236 have been made during the year from the Research Fund, and £22 15*s.* 3*d.* has been returned. Of the papers published in the *Transactions* during 1905, 24 were contributed by authors to whom grants had been made from the Research Fund.

In February of last year the Treasurer was fortunate enough to be able to increase the invested capital of the Society by almost exactly

£1,500 by the purchase of £1,983 Midland Railway 2½ per cent. Preference Stock for £1,499 14*s.* 5*d.* The income from all sources for the year 1905 exceeds that for 1904 by only £93 8*s.* 4*d.*, whilst the expenditure has been abnormally heavy, exceeding the total income by £305 1*s.* 5*d.* This is due to the incidence of several very heavy accounts, one of which really belongs to several years, and that is the completion of the Decennial Index for the period 1893–1902, which has entailed the expenditure this year of no less than £778 10*s.* 5*d.*, or rather more than half the total cost. No further expenditure, however, on account of Decennial Indexes will be required for several years to come. As pointed out last year, the continual increase in the cost of the *Journal* and *Proceedings* is a source of much anxiety, and this year a further increase has to be recorded on both accounts, £219 12*s.* 7*d.* in the former and £35 18*s.* 2*d.* in the latter case, or a net increase over the cost of both in 1904 of £255 10*s.* 9*d.*, and over that in 1903 of £578 3*s.* 3*d.* The Council therefore trust that authors of papers will do their utmost to assist the Publication Committee and the Treasurer in keeping down the cost of printing as far as possible.

The publication of the *Annual Reports on the Progress of Chemistry* has necessarily added materially to the expenditure of the Society; the cost of Volume I having entailed an expenditure of £445 19*s.* 6*d.*, of which about £70 has been recovered by their sale. Another item of some magnitude, £52 9*s.* 6*d.*, is the cost of the printing and circulating of the Bye-laws, together with the changes proposed by the Council, which were submitted to an Extraordinary General Meeting of the Society on February 8th, 1905.

The administrative expenses have been carefully kept in check, and whilst everything has been maintained in a state of thorough efficiency their amount is only £827 16*s.* 5*d.*, as against £893 1*s.* 0*d.* in 1904.

The following facts with regard to the cost of the Decennial Indexes may be of interest. The total cost of Volume IV, 1893–1902 (Parts I and II), exclusive of distribution amounts to £1,454 5*s.* 6*d.*, of which the cost of printing was £762 6*s.* 0*d.* The cost of Volume III, 1883–1892 (issued in one volume) was £1,280 2*s.* 7*d.*, of which the printing accounted for £585 19*s.* 7*d.* The cost of Volume IV was relatively considerably less than that of Volume III, as the former extended to 45½ sheets for the Authors' Index and 108 sheets for the Subject Index, or 153½ sheets in all, whilst Volume III only contained 102¾ sheets. Owing to the way in which the Annual Indexes are now prepared, it is hoped that when Volume V has to be undertaken, the relative cost will be still further reduced and that the chief cost will be that due to the printing.

The Treasurer gave a statement as to the Society's income and expenditure during the year 1905, and proposed a vote of thanks to the Auditors, which was seconded by Dr. BERNARD DYER and carried unanimously, acknowledgment being made by Dr. H. FORSTER MORLEY.

A vote of thanks to the Treasurer, Secretaries, Foreign Secretary, and Council for their services during the past year was proposed by Dr. T. E. THORPE, seconded by Sir THOMAS STEVENSON, and unanimously adopted. Sir WILLIAM RAMSAY responded.

The PRESIDENT then delivered his Address, entitled "The living organism as a chemical agency: A review of some of the problems of photosynthesis by growing plants."

Sir HENRY E. ROSCOE proposed a vote of thanks to the President, coupled with the request that he would allow his Address to be printed in the Society's *Transactions*. Dr. HORACE BROWN seconded the motion, which was carried by acclamation, and acknowledged by the President.*

The Scrutators then presented their Report to the President, who declared the following to have been duly elected as Officers and Council for the ensuing year:—

President: Raphael Meldola, F.R.S.

Vice-Presidents who have filled the office of President: H. E. Armstrong, Ph.D., LL.D., F.R.S.; A. Crum Brown, D.Sc., LL.D., F.R.S.; Sir William Crookes, D.Sc., F.R.S.; Sir James Dewar, M.A., LL.D., F.R.S.; A. Vernon Harcourt, M.A., D.C.L., F.R.S.; H. Müller, Ph.D., LL.D., F.R.S.; W. Odling, M.A., M.B., F.R.S.; W. H. Perkin, Ph.D., LL.D., F.R.S.; J. Emerson Reynolds, Sc.D., M.D., F.R.S.; Sir Henry E. Roscoe, LL.D., F.R.S.; W. J. Russell, Ph.D., F.R.S.; T. E. Thorpe, C.B., LL.D., F.R.S.; W. A. Tilden, D.Sc., F.R.S.

Vice-Presidents: Horace T. Brown, LL.D., F.R.S.; Harold B. Dixon, M.A., F.R.S.; Rudolph Messel, Ph.D.; W. H. Perkin, jun., Ph.D., F.R.S.; A. Smithells, B.Sc., F.R.S.; W. P. Wynne, D.Sc., F.R.S.

Treasurer: Alexander Scott, M.A., D.Sc., F.R.S.

Secretaries: M. O. Forster, D.Sc., Ph.D., F.R.S.; A. W. Crossley, D.Sc., Ph.D.

Foreign Secretary: Sir William Ramsay, K.C.B., LL.D., F.R.S.

* The Address will appear in the April number of the Journal.

Ordinary Members of Council: Edward C. C. Baly; Bernard Dyer, D.Sc.; William Gowland; Alfred D. Hall, M.A.; H. A. D. Jowett, D.Sc.; A. Lapworth, D.Sc.; J. E. Marsh, M.A.; F. E. Matthews, Ph.D.; G. T. Moody, D.Sc.; A. G. Perkin, F.R.S.; W. J. Sell, M.A., F.R.S.; John Wade, D.Sc.

Thursday, April 5th, 1906, at 8.30 p.m., Professor R. MELDOLA, F.R.S., President, in the Chair.

The PRESIDENT announced the donation by Mr. John Spiller of a Berzelius medal in selenium, which had been in the possession of the donor during the past fifty years.

It was also stated that the Council had appointed the following Committees:

Finance Committee.—E. G. Hooper, G. T. Moody, H. T. Brown, T. E. Thorpe, W. A. Tilden, and the Officers.

House Committee.—W. R. Dunstan, J. E. Reynolds, W. J. Russell, J. M. Thomson, T. E. Thorpe, W. A. Tilden, and the Officers.

Library Committee.—E. C. C. Baly, B. H. Brough, F. D. Chattaway, B. Dyer, A. Harden, C. A. Keane, A. Lapworth, E. J. Mills, J. Millar Thomson (*Chairman*), J. A. Voelcker, J. Wade, the Editor, and the Officers.

Publication Committee.—H. E. Armstrong, E. C. C. Baly, B. Dyer, E. J. Mills, W. A. Tilden, J. Wade, and the Officers.

Research Fund Committee.—H. T. Brown, W. R. Dunstan, P. F. Frankland, A. D. Hall, G. Matthey, R. Messel, H. Müller, W. H. Perkin, jun., S. P. U. Pickering, W. A. Tilden, and the Officers.

Messrs. T. V. Barker and I. B. Hobsbaum were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs:

Percy Corlett Austin, M.A., Queen's College, Galway.
Lionel John Drinkwater, 27, Stokenchurch Street, Fulham, S.W.
Bernhard Flurscheim, Ph.D., Heatherlands, Fleet, Hants.
Edgar Percy Hedley, 6, Royal Terrace West, Kingstown, Co. Dublin.
Arthur Edwin Hill, 236, Willesden Lane, Brondesbury, N.W.
Frederick Gowland Hopkins, M.A., M.B., D.Sc., F.R.S., Stafford House, Newnham, Cambridge.
Thomas Macdonald, North Frodingham, Driffield, Yorkshire.

Harold Lawson Pendlebury, 4, Wentworth Street, Bolton.
Percy George Pennymore, Eskbank Iron and Steel Works, Lithgow, N.S.W.
Walter Hansen Rawles, 81, Lewisham High Road, S.E.
John Senior, Sizing Hill, Batley Carr, Dewsbury.
Emanuel George Stirimer, Park House, Margery Park Road, Forest Gate, E.
Richard Lumley Treble, B.Sc., The School Lodge, Cranbrook, Kent.
Robert Hutchison Turnbull, Messrs. MacAndrews & Forbes Co., Smyrna, Turkey-in-Asia.
Charles Wightman, 43, Portland Place, W.

Of the following papers, those marked * were read:

***67. "An improved apparatus for measuring magnetic rotations and obtaining a powerful sodium light." By William Henry Perkin, sen.**

The author dealt with the advantages and disadvantages of the ordinary electro-magnet with pierced pole-pieces and also the long coil or helix as a means of obtaining a magnetic field suitable for the measurement of magnetic rotations, and the desirability of obtaining an apparatus which shall possess all the advantages without the disadvantages of either of these systems. This has been effected by using a short but very powerful coil and a powerful electric current. The coil is cased with steel and has a three-inch gun-metal tube through the centre, the interior of this being the position of the magnetic field. The glass measuring tubes are supported in this tube in a metal trough which can be kept at any required temperature. Reference was also made to the measurement of the plane of polarisation and the difficulties which arise from the fact that the sodium flame is not purely monochromatic. This defect was especially felt when measuring large rotations and was successfully overcome by the use of a direct vision prism attached to the eye-piece or placed in the telescope of the analyser; through this a distinct image of the half-shadow disc is observed; this disc is on the analyser in the apparatus used: the prismatic colours arising from the impurity of the sodium flame are seen on either side of the image. Lastly, a method of obtaining a powerful sodium light was described, which consists in employing a large Bunsen burner with a fine tube up the centre which is supplied with oxygen. This burner, placed under a platinum boat containing sodium chloride, is heated by the ordinary flame, which keeps the sodium chloride in a state of semi-fusion, whilst the internal flame, produced by the oxygen passing up the small tube, impinges on

the side, and at the same time somewhat under the boat; this causes the sodium chloride to volatilise, and at the same time the part of the flame passing up the side receives the sodium chloride vapour and gives a very intense, yellow light, which can be maintained for a long time.

Discussion.

After referring to the fact that Dr. Perkin had this year been fifty years a Fellow of the Society, Professor Armstrong expressed the opinion that probably in days to come, when physicists understood sufficient chemistry to appreciate Dr. Perkin's work on magnetic rotation, it would be regarded as of greater importance even than his discovery of the coal-tar colours.

The President, in moving a vote of thanks to Dr. Perkin, congratulated him on having brought to its present state of perfection the beautiful method of exploring chemical constitution by an optical method which he had conceived twenty-five years ago, and which he had practically made his own. The apparatus described was unfortunately not an ordinary laboratory installation, and he was therefore afraid that Dr. Perkin was likely to bring more work upon himself, since the discoverers of new compounds would more and more have to depend on him for the determination of magnetic rotations when, as was certain to be the case, the value of the method became more widely recognised. The President reminded the meeting how largely the pages of the Transactions already bore testimony to the value of the method and to the courtesy of the author in placing his services at the disposal of investigators.

*68. "The rusting of iron." By Gerald Tattersall Moody.

Contrary to the statement of Dunstan, Jowett, and Goulding (*Trans.*, 1905, **87**, 1548), it is found that when bright iron is left in contact with air and water, both of which have been completely freed from carbonic acid, the metal remains untarnished, whatever the duration of the exposure. No absorption of atmospheric oxygen by iron takes place in presence of water, provided that carbonic acid has been first removed from both air and water, but on admission of a small quantity of the gas, rapid oxidation of the metal and diminution in volume of the oxygen are observed.

It is found, moreover, that the composition of iron rust is not fairly represented by the formula $Fe_2O_2(OH)_2$, as stated by the foregoing investigators. An examination of a number of recently formed specimens shows that a large proportion of the iron is invariably present in the ferrous state, partly as oxide and partly as carbonate.

The explanation of rusting as a process involving the production of hydrogen peroxide, as advanced by Dunstan, is directly negatived by experimental evidence, which shows that atmospheric corrosion results first from the interaction of iron and carbonic acid, whereby ferrous salt is formed, and subsequently from the more or less complete oxidation of ferrous salt by oxygen.

Discussion.

Prof. Armstrong said that, having seen the work, he was able to testify to the extreme care and patience which Dr. Moody had devoted to the inquiry; the experiments had been made without bias, solely with the object of ascertaining whether iron were oxidisable by water and oxygen alone. The result was beyond question. It was not creditable to chemists, however, that problems of such fundamental importance should have so long been neglected in favour of work of no particular value to anyone, and that it should still be possible to dispute on such questions. Notwithstanding all the talk about ions, we were still without any clear accepted doctrine as to the conditions which determined the attack of oxygen on metals. Personally he had never been in doubt since he had realised that all such actions were essentially electrolytic—he had therefore felt unable to believe in the possibility of the interaction of iron, oxygen, and water taking place in the absence of an electrolyte—water not being an electrolyte. He had also never been able to accept the peroxide explanation; even supposing that rusting were inhibited by all substances which decomposed the peroxide, there was no reason to suppose that the destruction of the peroxide could in any way prevent the oxidation of the metal; some other explanation must be sought for the stoppage of action.

Mr. A. R. Ling recounted his experiences with an acid water, derived from the red sandstone of Somersetshire, which vigorously attacked iron, producing rust. This action was prevented by adding to the water 7 grains per gallon of lime, but an equivalent amount of sodium carbonate was without effect. Caustic alkalis in equivalent amount prevented rusting only so long as the water was kept out of contact with the atmosphere. Rusting occurred also in presence of alkali sulphites.

Dr. Goulding pointed out that the hydrogen peroxide solutions employed in Dunstan, Jowett, and Goulding's experiments did not contain free mineral acid, as Dr. Moody had stated, but were purified in all cases. The method usually adopted was to shake the solution thoroughly with barium carbonate, and afterwards to boil it under reduced pressure in order to eliminate carbon dioxide.

Mr. W. A. Davis referred to the opinion expressed by Prof.

Dunstan and his colleagues in their paper, that Dr. Moody had "misread" the account given by Giorgis (*Gazzetta*, 1891, 21, 510) of the action of hydrogen peroxide on magnesium. The tenor of this paper is to show that hydrogen peroxide when freed as far as possible from carbon dioxide attacks magnesium very much less readily than ordinary hydrogen peroxide containing carbon dioxide. Dr. Moody's statement that "hydrogen peroxide when carefully freed from carbon dioxide is *practically without action* on magnesium," is but a paraphrase of Giorgis' own conclusion that pure magnesium "è ossidato *in minima quantità* dall' acqua ossigenata neutra." Giorgis' hydrogen peroxide was not strictly neutral, but very slightly acid (*appena acida*), a fact which perhaps accounts for there being any action at all.

Dr. H. Borns said that Dr. Moody had certainly taken great pains to settle the problem definitively, but he should, however, have prevented the possibility of access of ozone, nitrogen compounds, sulphurous acid, &c., when finally admitting the air.

Dr. Moody, in reply, said that the method of purifying hydrogen peroxide, as detailed by Dr. Goulding, was obviously inadequate, since in removing one impurity others were introduced. He doubted if acid could be completely removed by such a process without decomposing the whole of the hydrogen peroxide in the solution. With regard to Dr. Borns' remark, the arrangements for scrubbing the air were such that all acid constituents likely to attack iron were eliminated.

***69. "The estimation of carbon in soils." By Alfred Daniel Hall, Norman Harry John Miller, and Numa Marmu.**

Wet combustion with chromic acid has been frequently used for the estimation of carbon in soils, but, as Warington has pointed out, it always gives results too low by 10—20 per cent. This is due to the oxidation of the carbon compounds not proceeding so far as carbon dioxide, and is shown by the authors to be obviated by the introduction of a short length of red-hot copper oxide between the reacting flask and the alkali used for absorbing the carbon dioxide. The authors employ a Reiset tower for absorbing the carbon dioxide, which is then estimated by double titration, as suggested by Brown and Escombe.

Discussion.

Dr. Voelcker thought the process described would be a good one, and it had the advantage that both the carbonic acid and the organic carbon could be estimated in the one portion of soil. It would be interesting to know whether the authors had made a comparative test by Pettit and Schaub's method (*J. Amer. Chem. Soc.*, 1904, 26, 1640), which consisted in combustion with sodium peroxide.

70. "Electrolysis of salts of $\beta\beta'$-dimethylglutaric acid." By James Walker and John Kerfoot Wood.

Sodium ethyl $\beta\beta'$-dimethylglutarate, when electrolysed in concentrated aqueous solution, yields as chief product the diethyl ester of $\beta\beta\beta'\beta'$-tetramethylsuberic acid. This ester, the corresponding acid, and some of its salts are described.

Sodium $\beta\beta'$-dimethylglutarate under like conditions yields at the anode chiefly carbon monoxide and carbon dioxide. There is formed simultaneously, however, a small quantity of a pentene, C_5H_{10}, which was proved to be unsymmetrical methylethylethylene. The formation of this compound can only be explained on the assumption of the migration of a methyl group. This affords an analogue to the production of ethyl *iso*lauronolate on the electrolysis of sodium ortho-ethylcamphorate.

71. "Bromo- and hydroxy-derivatives of $\beta\beta\beta'\beta'$-tetramethylsuberic acid." By John Kerfoot Wood.

Perkin and Thorpe (*Trans.*, 1899, **75**, 48) found that the bromo-esters of $\beta\beta$-dimethylglutaric acid, when heated with alcoholic potash, lose hydrogen bromide and are converted into the caronic acids. The author has investigated the action of alcoholic potash on the bromo-derivatives of $\beta\beta\beta'\beta'$-tetramethylsuberic acid, the ester of which is the direct synthetical product obtained during the electrolysis of sodium ethyl $\beta\beta$-dimethylglutarate. The action in this case is of a different nature from that investigated by Perkin and Thorpe; no cyclic compounds were formed, the only products isolated being hydroxy-derivatives of $\beta\beta\beta'\beta'$-tetramethylsuberic acid.

72. "Some new *o*-xylene derivatives." By George Stallard.

A new bromo-*o*-xylene ($CH_3 : CH_3 : Br = 1 : 2 : 3$) is obtained by hydrolysis of a bromosulphonic acid obtained by Kelbe by brominating *o*-xylene-4-sulphonic acid.

On sulphonation, it gives a mixture of two acids, one of which, the major product, has its substituents in the following positions: $CH_3 : CH_3 : Br : SO_3H = 1 : 2 : 3 : 6$, as on debromination the *o*-xylene-3-sulphonic acid is obtained from it. The substituents of the other acid are present in the positions: $CH_3 : CH_3 : Br : SO_3H = 1 : 2 : 3 : 4$ or $1 : 2 : 3 : 5$, as the compound is identical with Kelbe's acid mentioned above, and isomeric with the acid

$$CH_3 : CH_3 : Br : SO_3H = 1 : 2 : 4 : 5,$$

obtained by Jacobsen by sulphonating 4-bromo-*o*-xylene.

73. "A new solvent for gold. Preliminary note." By James Moir.

The author finds that gold-leaf dissolves fairly readily when floated on an acid solution of ordinary thiocarbamide. The action is rapid when a suitable oxidising agent is added: for example, when a solution of thiocarbimide is acidified and treated with a little ferric chloride, potassium dichromate, or hydrogen peroxide, the mixture dissolves gold-leaf after less than a minute's shaking. The solution is not precipitated either by ferrous sulphate or by stannous chloride (except after long standing), whence it follows that the gold is present in solution as part of a complex ion. The gold compound has been isolated in brilliant, colourless, six-sided lozenges, striated parallel to the longest axis, and is identical with a compound which the author has obtained by boiling a mixture of sodium aurichloride and thiocarbamide solutions. It is apparently different from the compound $AuCl,2CH_4N_2S$, described by Emerson Reynolds and by B. Rathke as being obtained in the reaction between aurichloride and thiocarbamide, since the mean of four concordant analyses gave Au = 45·42, whereas $AuCl,2CH_4N_2S$ requires 51·24 per cent. Both Reynolds and Rathke give the theoretical value for gold in this compound as about 51·05, owing to the use of an incorrect value for the atomic weight of gold.

74. "The molecular condition in solution of ferrous oxalate. A correction." By Samuel Edward Sheppard and Charles Edward Kenneth Mees.

In a paper on this subject (*Trans.*, 1905, **87**, 189), the authors found for the dissociation-constant $\frac{[Fe(C_2O_4)_2'']}{[C_2O_4'']}$ the value 0·81 at 20°. Abegg and Schäfer working at 25° find the value 0·37, a discrepancy too considerable to be due to the temperature difference. Professor Abegg, who has very kindly brought this circumstance to the authors' notice, has also pointed out the cause of this discrepancy. This was due to an error in the authors' calculation, whereby in calculating the concentration of $Fe(C_2O_4)_2''$ the permanganate titre for C_2O_4'' was added. The correct calculation is as follows. The increase in the permanganate titre being 68·4 c.c., of this two-thirds are equal to 45·7 molecules of FeC_2O_4 dissolved. These 45·7 mols. of FeC_2O_4, taking 45·7 mols. of C_2O_4'' from the 197·8 mols. of C_2O_4'' originally present, form 45·7 mols. of $Fe(C_2O_4)_2''$ and leave $197·8 - 45·7 = 152·1$ mols. C_2O_4'', so that $K = \frac{45·7}{152·1} = 0·30$.

From the accepted results with longer time of stirring, the recalculated value for K is 0·39 at 20°, in good agreement with Abegg and Schäfer's value 0·37 at 25° (*Zeit. anorg. Chem.*, 1905, **45**, 317).

75. "Acetyl and benzoyl derivatives of phthalimide and phthalamic acid." By Arthur Walsh Titherley and William Longton Hicks.

Phthalic anhydride, like succinic anhydride (*Trans.*, 1904, **85**, 1679), interacts with sodium benzamide, as well as sodium acetamide, yielding the corresponding acylphthalamic acids,

$$CO_2H\cdot C_6H_4\cdot CO\cdot NH\cdot COR.$$

The latter readily undergo internal condensation on treatment with acetyl chloride, giving the acylphthalimides, $C_6H_4\langle\begin{matrix}CO\\CO\end{matrix}\rangle N\cdot COR$, identical with products obtained by the acylation of phthalimide, namely, benzoylphthalimide by pyridine benzoylation and acetylphthalimide, which has already been described by Aschan (*Ber.*, 1886, **19**, 1400), by heating phthalimide with acetic anhydride.

Both acylphthalimides decompose on cautiously warming with aqueous sodium carbonate, the imide ring undergoing hydrolytic rupture with formation of the corresponding acylphthalamic acid, $CO_2H\cdot C_6H_4\cdot CO\cdot NH\cdot COR$. Aschan, on the other hand, stated that acetylphthalimide was hydrolysed with alkalis, giving phthalimide and acetic acid. The authors cannot confirm this observation, but show that when hydrolysis occurs it is preceded by rupture of the cyclic imido-grouping. Similar observations have been made by one of the authors (*Trans.*, 1904, **85**, 1686) in the case of benzoylsuccinimide, which on hydrolysis first yields benzoylsuccinamic acid, and finally succinic and benzoic acids and ammonia.

76. "The dynamic isomerism of phloroglucinol." By Edgar Percy Hedley.

It is well known that alkalis and acids affect the equilibrium existing between two isomerides in solution, and that the action of the alkali is to increase the oscillatory change in one direction, whilst the acid, on the other hand, decreases it.

If phloroglucinol exists in solution in two forms—the enolic and ketonic modifications—then the position and persistency of the absorption band ought to undergo modification in the presence of alkali, and ought, in fact, to be displaced towards the less refrangible end of the spectrum. On the other hand, in the presence of acid, the persistency of the band ought to be decreased and become more like that of

phloroglucinol trimethyl ether. These arguments were fully borne out by experimental test.

Lowry has pointed out that in some cases the solvent affects the equilibrium between dynamic isomerides. It was therefore thought advisable to examine whether in the case of phloroglucinol the solvent had any effect. Any non-ionising solvent would be suitable, provided it transmitted the ultra-violet light to a sufficient extent. Accordingly ether, a good and diactinic solvent, was used, and was found to have no effect on the spectrum.

The following conclusions were established: (1) that in neutral solutions phloroglucinol exists in both modifications, the enol being greatly in preponderance over the keto-form, and (2) that this equilibrium is undisturbed by the class of solvent.

77. "Studies in asymmetric synthesis. V. Asymmetric syntheses from *l*-bornyl pyruvate." By Alexander McKenzie and Henry Wren.

The authors have examined the reduction of *l*-bornyl pyruvate by aluminium amalgam, and find that an asymmetric synthesis of *l*-lactic acid may be accomplished in accordance with the scheme:

$$CH_3\cdot CO\cdot CO_2H \text{ (inactive)} \longrightarrow CH_3\cdot CO\cdot CO_2\cdot C_{10}H_{17}^{*} \text{ (active)}$$
$$\longrightarrow CH_3\cdot \overset{*}{C}H(OH)\cdot CO_2\cdot C_{10}H_{17}^{*} \text{ (active)}$$
$$\longrightarrow CH_3\cdot \overset{*}{C}H(OH)\cdot CO_2H \text{ (active)}.$$

The actions of magnesium ethyl iodide, magnesium *iso*butyl iodide, magnesium phenyl bromide, and magnesium α-naphthyl bromide respectively on *l*-bornyl pyruvate, and of magnesium *iso*butyl iodide and magnesium α-naphthyl bromide respectively on *l*-menthyl pyruvate, have been studied. The results obtained are contrasted with those recorded in a previous paper with the object of comparing the effect, first, of the active menthyl and bornyl groups, and, secondly, of the various alkyl (or aryl) halides used on the extent of the asymmetric syntheses of the resulting substituted glycollic acids.

78. "1-Methyl*cyclo*hexylidene-(4)-acetic acid." By William Henry Perkin, jun., and William Jackson Pope.

The current number of the *Berichte* (1906, **39**, 1171) contains a paper by W. Markwald and R. Meth, in which these investigators describe the synthesis of an acid to which they assign the formula

$$CHMe\begin{<}CH_2\cdot CH_2\\CH_2\cdot CH_2\end{>}C{:}CH\cdot CO_2H,$$

and which they have resolved into active modifications by fractional crystallisation of the cinchonine salts.

During the last three years, the authors have been engaged in an attempt to prepare a substance which, while not containing an asymmetric carbon atom, is yet capable of existing in optically active modifications, and it is noteworthy that one of the substances selected for examination was methyl*cyclo*hexylideneacetic acid. Since, however, the method of preparation is quite different from that of Markwald and Meth, and the results obtained are not in agreement with theirs, the following preliminary account of the authors' experiments is now put forward.

Ethyl hexahydro-*p*-toluate is converted into *hexahydro*-p-*tolylcarbinol*, $CHMe\langle^{CH_2\cdot CH_2}_{CH_2\cdot CH_2}\rangle CH\cdot CH_2\cdot OH$, by reduction with sodium and alcohol. This carbinol distils at 197° and is readily converted into *hexahydro*-p-*tolyl bromide* (b. p. 135°/150 mm.) by the action of hydrobromic acid at 120°. When this bromide is heated with potassium cyanide and the product hydrolysed, it yields *hexahydro*-p-*tolylacetic acid*, $CHMe\langle^{CH_2\cdot CH_2}_{CH_2\cdot CH_2}\rangle CH\cdot CH_2\cdot CO_2H$, which melts at 73—74° and is readily acted on by phosphorus pentachloride and bromine with formation of *α-bromohexahydro*-p-*tolylacetic acid* (m. p. 78°), $CHMe\langle^{CH_2\cdot CH_2}_{CH_2\cdot CH_2}\rangle CH\cdot CHBr\cdot CO_2H$.

The ester of this bromo-acid is decomposed by boiling with diethylaniline with elimination of hydrogen bromide and formation of *ethyl methyl*cyclo*hexylideneacetate*, which distils at 158°/100 mm., and, on hydrolysis, yields the free acid, $CHMe\langle^{CH_2\cdot CH_2}_{CH_2\cdot CH_2}\rangle C{:}CH\cdot CO_2H$.

The methyl*cyclo*hexylideneacetic acid thus obtained crystallises from formic acid in glistening plates and melts at 70—71°, whereas the acid described by Markwald and Meth, and to which these authors assign this constitution, melts sharply at 40—41°.

The method of preparation seems to leave no doubt that the acid melting at 70—71° is methyl*cyclo*hexylideneacetic acid, whilst the acid of melting point 40—41° described by Markwald and Meth is possibly the isomeric acid, $CHMe\langle^{CH_2-CH}_{CH_2\cdot CH_2}\rangle C\cdot CH_2\cdot CO_2H$.

The fact that, when heated with strong caustic potash, it is decomposed into 4-methyl*cyclo*hexanone, $CHMe\langle^{CH_2\cdot CH_2}_{CH_2\cdot CH_2}\rangle CO$, and acetic acid is easily explained on this assumption.

It is well known that an unsaturated acid which contains the double linking in the $\beta\gamma$-position is readily converted, by the action of strong caustic potash, into the corresponding $\alpha\beta$-unsaturated acid, and

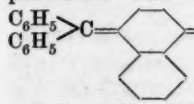
this isomeric change may have taken place in the case of Markwald and Meth's acid prior to the decomposition into methyl*cyclo*hexanone and acetic acid.

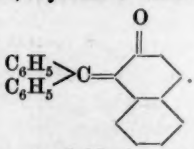
The authors are investigating this matter further, and are also engaged in a series of experiments with the object of resolving the acid melting at 70—71° into optically active modifications.

79. "Condensation of benzophenone chloride with α- and β-naphthols." By George William Clough.

By heating α-naphthol with benzophenone chloride, the author has prepared di-α-hydroxynaphthyldiphenylmethane, the acetyl and benzoyl derivatives of which have also been obtained.

When benzophenone chloride was added to a boiling solution of β-naphthol in xylene, the product obtained was di-β-naphthoxydiphenylmethane, which is hydrolysed by dilute sulphuric acid into β-naphthol and benzophenone.

The action of sodium α-naphthoxide on benzophenone chloride resulted in the formation of the inner anhydride of α-naphthyldiphenylcarbinol, and the same substance was also obtained by adding α-naphthol to a boiling solution of the ketone chloride in light petroleum. This compound is yellow and the quinonoid formula,  , has been assigned to it.

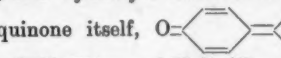
Sodium β-naphthoxide interacts with benzophenone chloride in a similar manner to form a red, crystalline substance, to which the following formula is ascribed:  .

These coloured compounds are soluble in concentrated sulphuric, nitric, and hydrochloric acids respectively, the α-compound giving violet and the β-compound green solutions in these acids.

A condensation of benzophenone itself with α-naphthol has also been effected by heating these substances in the presence of zinc chloride and hydrogen chloride at 150—160°. The product obtained was α-oxydinaphthyldiphenylmethane, $C(C_6H_5)_2<^{C_{10}H_6}_{C_{10}H_6}>O$, the condensation resembling that of acetone with α-naphthol (Dianin, Abstr., 1893, i, 214). Its solution in concentrated sulphuric acid is yellow and exhibits a green fluorescence.

80. "The constitution of cœrulignone (cedriret). A preliminary note." By James Moir.

On the authority of Liebermann, Hofmann, and others, it has been accepted that cœrulignone is tetramethoxyldiphenoquinone: in addition, several strictly analogous substances have been prepared and formulated by their discoverers as the corresponding tetra-chloro-, -bromo-, -amino-, and -hydroxy-derivatives of diphenoquinone.

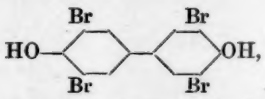
Now diphenoquinone itself,  , has recently been prepared by Willstätter and Kalb (*Ber.*, 1905, **38**, 1232), and the author finds that its properties are quite different from those of cedriret and its analogues, and that, in fact, diphenoquinone is a true para-quinone, whereas cedriret and its analogues do not possess any quinonoid property except colour. Their properties are: (1) complete insolubility in organic solvents; (2) metalloid lustre; (3) decomposition on heating without melting or subliming; (4) intense colorations—blue to crimson—with sulphuric acid; (5) characteristic colour reactions with alkali; (6) production of complex sulphonates of high molecular weight through the action of sodium sulphite. Such properties as these indicate molecular complexity and a polyquinonoid constitution.

The author finds that the "diphenoquinhydrone" of Willstätter and Kalb (*loc. cit.*) is the true parent substance of cedriret, since it possesses all the foregoing properties. Nevertheless, it is doubtful at present whether this substance is really a simple quinhydrone, that is, a direct additive product of diphenoquinone and diphenol; some of its reactions indicate a larger molecular weight and higher percentage of oxygen than the formula $C_{24}H_{18}O_4$ requires.

The substance described by Magatti as tetrabromodiphenoquinone (*Ber.*, 1881, **13**, 226) has been studied more in detail. In the first place, it is quite different from the true tetrabromodiphenoquinone, which the author has prepared by oxidising tetrabromodiphenol with lead peroxide, and which forms transparent, orange crystals, is soluble in many organic solvents, and otherwise resembles diphenoquinone. Magatti's substance contains a lower percentage of bromine than is required by such a formula as $C_{12}H_4O_2Br_4$, and Magatti's analysis in support of this formula may be set aside as probably fictitious, since he has miscalculated the theoretical proportion of bromine and yet his analysis agrees with the assumed theoretical value. The compound gives, even in traces, a magnificent crimson shade with sulphuric acid, and on digestion with alkali forms a derivative which closely resembles indigotine in colour and coppery lustre; this can be also prepared

directly by careful oxidation of an alkaline solution of tetrabromodiphenol with iodine or potassium ferricyanide.

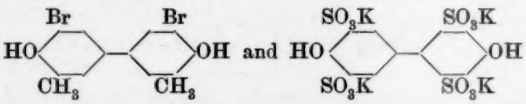
The orientation of the bromine atoms in tetrabromodiphenol has been settled to be as in the formula



(3 : 5 : 3′ : 5′-tetrabromo-4 : 4′-diphenol).

since the sole product of the oxidation of its diacetate was 3 : 5-dibromo-4-acetonylbenzoic acid.

Finally, two new analogues of cedriret have been prepared by oxidising the compounds



respectively; the former has a green, graphite-like lustre and gives a maroon shade with sulphuric acid, whilst the latter, easily soluble in water, has a very dark indigo colour.

81. "A comparative crystallographic study of the perchlorates and permanganates of the alkalis and the ammonium radicle." By Thomas Vipond Barker.

The perchlorates of potassium, rubidium, cæsium, and ammonium form an isomorphous group similar to that of the permanganates of the same metals, which were investigated by Muthmann. The salts are orthorhombic and possess perfect cleavages parallel to the basal plane and the prism. All the constants of rubidium perchlorate determined are intermediate between those of potassium and cæsium perchlorates; ammonium perchlorate, again, lies very close to rubidium perchlorate, as does also thallium perchlorate according to Roscoe's measurements. The series, therefore, resembles the isomorphous groups investigated by Tutton. On comparing the perchlorates with the permanganates, it is found that the effect of replacing an atom of chlorine by one of manganese is much the same as that induced by the substitution of sulphur by selenium, say, in the sulphates of the same metals. The crystallographic evidence for placing manganese in the seventh group of the periodic classification, so far as such evidence goes, is therefore of the strongest possible kind.

Five crops of isomorphous mixtures of potassium perchlorate and permanganate of varying composition were measured. In one crop

only, corresponding very closely to the formula $K_2(ClO_4)(MnO_4)$, were abnormal angles found, that is, angles the values of which lie outside those of the constituent salts; moreover, these angles were all in one zone, in which the faces were possibly vicinal.

82. "Contributions to the theory of isomorphism based on experiments on the regular growths of crystals of one substance upon those of another." By Thomas Vipond Barker.

The parallel growths of sodium nitrate on cleavage surfaces of calcite are independent of the locality or variety of the calcite so long as a good, fresh cleavage surface is obtainable. Regular growths of rhombohedra of the nitrate were also obtained upon certain other forms of calcite, for example, the prism, scalenohedron, a steep rhombohedron, and the rare prism $\{\bar{1}10\}$; in all cases a pair of similar edges of the calcite and sodium nitrate are congruent. The effect of a magnetic field on the orientation of the crystals was purely negative. No parallel or regular growths could be obtained on the other minerals of the calcite group—dolomite, calamine, chalybite, rhodocrosite, diallogite, and breunnerite—nor on barytocalcite. The failure of the latter minerals to induce a parallel deposition is probably not due to a difference of symmetry or of angle (or axial ratio), but to a dissimilarity of molecular volume, and hence of topic axes also.

This view is strengthened by the discovery of parallel growths among the members of another and more numerous series of isostructural minerals and salts: potassium perchlorate and permanganate are deposited (from aqueous solution) upon barytes, celestine, and anglesite in parallel position, whereas the perchlorates of rubidium, cæsium, ammonium, and thallium and the permanganates of rubidium, cæsium, and ammonium are not. Here, again, those salts which do form parallel growths are characterised by a closeness of molecular volume to those of the minerals on which they are deposited, while similarity of angle (or of axial ratios) is not sufficient to induce a parallel growth. If the above substances be arranged in order of topic axes, it is seen that potassium perchlorate and permanganate fall next to the three minerals mentioned.

Since calcite and sodium nitrate resemble each other so closely in all their physical properties, and since calcite relieves supersaturation in a metastable solution of the nitrate, the conclusion is drawn that these isostructural substances are also to be regarded as isomorphous, although mixed crystals are not obtainable.

Many unsuccessful attempts were made to obtain regular growths of other salts on other minerals, more especially of cubic salts on cubic minerals and potassium nitrate on aragonite; but regular growths of

potassium bromide, iodide, and nitrate and sodium nitrate on mica, and of quinol on calcite, were obtained.

All the perchlorates and permanganates mentioned yield parallel growths on each other, but it was found that pairs of isomorphous salts, the molecular volumes of which are almost identical, form zonal growths ("Schichtkrystalle") rather than parallel growths.

83. "Constitution of salicin. Synthesis of pentamethyl salicin." By James Colquhoun Irvine and Robert Evstafieff Rose.

Salicin was alkylated by means of the joint action of silver oxide and methyl iodide, with the production of pentamethyl salicin. The process was carried out in the first instance in methyl-alcoholic solution, and, after the alkylation had proceeded far enough, methyl iodide was used as solvent. The product crystallised in delicate needles (m. p. 62—64°), readily soluble in organic solvents and giving $[\alpha]_D^{20^\circ} - 52{\cdot}15^\circ$ in alcoholic solution.

Emulsin was found to be without action on the compound, and even dilute mineral acids readily converted it into a resinous mass resembling saliretin. The hydrolysis was therefore carried out indirectly by prolonged heating at 100° of a solution of the substance in methyl alcohol containing 0·25 per cent. of hydrochloric acid. Tetramethyl glucose was thus produced and afterwards converted into the equilibrium mixture of α- and β-tetramethyl methylglucosides. The alkylated glucosides were isolated and then hydrolysed to give tetramethyl glucose (m. p. 84—86°).

This reaction proves that salicin (and hence also helicin and populin) contains the same γ-oxidic linking as the methylglucosides and sucrose.

Further evidence on this point was obtained in the synthetical preparation of pentamethyl salicin. On heating saligenin and tetramethyl glucose to 120° in benzene containing 0·25 per cent. of hydrochloric acid, condensation took place with the formation of a mixture of saligenin tetramethyl glucosides and octamethyl glucosidoglucoside. After separation of the alkylated dissaccharide, the mixture was methylated by the silver oxide reaction and a compound, identical in every respect with the pentamethyl salicin prepared directly from the glucoside, was isolated from the product.

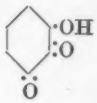
84. "A product of the action of *iso*amyl nitrite on pyrogallol." By Arthur George Perkin and Alec Bowring Steven.

When an alcoholic solution of pyrogallol is oxidised with acetic acid and *iso*amyl nitrite, a small quantity (1·3 per cent.) of pale salmon-coloured leaflets separate (m. p. 203°). The main bulk of this product

is colourless, may be obtained as minute prisms melting at 206—208° with effervescence, and has the composition $C_6H_4O_3$. With acetic acid and zinc dust it gives pyrogallol, with acetic anhydride and zinc dust *triacetylpyrogallol* (m. p. 160—162°); its acetyl derivative,

$$C_6H_3O_3(C_2H_3O),$$

forms colourless leaflets (m. p. 283—285°), and also yields triacetylpyrogallol in a similar manner. The substance $C_6H_4O_3$ dissolves sparingly in boiling acetic acid and alcohol with some decomposition, and by means of boiling water yields purpurogallin, $C_{11}H_8O_5$. The reaction studied in detail with the crude substance (m. p. 203°) showed that in this way a compound $C_{12}H_{10}O_7$? (colourless prisms, m. p. 242—243°) and an orange-brown resin, both readily soluble in water, are also formed. Owing to the poor yield it has not been possible to study this product further, but it appears likely that it may consist of *hydroxy-o-benzoquinone*:



85. "A reaction of ellagic and flavellagic acids." By Arthur George Perkin.

When ellagic acid is heated at about 230° with 100 per cent. sulphuric acid, it is oxidised with formation of a new compound which crystallises from pyridine in small, yellow, prismatic needles and is soluble in strong alkalis with a greenish-yellow tint, changing to blue on dilution. It appears to have the formula $C_{14}H_6O_{10}$ (found C = 50·01; H = 2·17), gives a *hexacetyl* derivative [needles, $C_{14}H_{10}(C_2H_3O)_6$, m. p. 324—329°; found C = 53·18; H = 3·32; $C_{14}H_6O_{10}$ = 57·24], and dyes mordanted fabrics more readily than ellagic acid. Flavellagic acid behaves similarly [found for $C_{14}H_6O_{10}$, C = 50·09; 2·08; and for $C_{14}O_{10}(C_2H_3O)_6$, C = 53·12; H = 3·34 per cent.].

86. "Some thio- and dithio-carbamide derivatives of ethyleneaniline and the ethylenetoluidines." By Oliver Charles Minty Davis.

In the interaction of ethyleneaniline and the ethylenetoluidines with the thiocarbimides, several instances of steric hindrance were observed, the position of the substituent methyl group in the ethylenetoluidines and the tolylthiocarbimide having an important bearing both on the time of reaction and also on the nature of the product.

One molecule of ethyleneaniline unites with two molecules of allyl-,

phenyl-, *o*-tolyl-, or *p*-tolyl-thiocarbimide to form symmetrical dithiocarbamide derivatives, but with *m*-tolylthiocarbimide only 1 molecule of each unites to form an asymmetrical substituted thiocarbamide. Ethylene-*o*-toluidine reacts with difficulty to give asymmetrical derivatives with phenyl-, *m*-tolyl-, and *p*-tolyl-thiocarbimides, whilst with allyl- and *o*-tolyl-thiocarbimides the yield was exceedingly small. Ethylene-*m*-toluidine gives symmetrical derivatives with phenyl- and *p*-tolyl-thiocarbimides, but with allyl-, *o*-tolyl-, and *m*-tolyl-thiocarbimides asymmetrical derivatives result. Ethylene-*p*-toluidine gives an asymmetrical derivative with *m*-tolylthiocarbimide, but with other thiocarbimides symmetrical derivatives are formed.

With the ethylenetoluidines, the ortho- and meta-positions therefore seem to modify the reactions, but with the thiocarbimides the meta-position only has this effect.

The foregoing compounds interact with mercuric oxide in alcoholic solution when heated at about 140° in sealed tubes, oxygen replacing sulphur. The product from ethyleneaniline and phenylthiocarbimide appears to be identical with a compound synthesised from ethyleneaniline and phenylcarbimide.

At the next Ordinary Meeting, on **Thursday**, May 3rd, 1906, at 8.30 p.m., there will be a ballot for the election of Fellows, and the following paper will be read:

"The relation between absorption spectra and chemical constitution. Part V. The *iso*nitroso-compounds." By E. C. C. Baly, E. G. Marsden, and A. W. Stewart.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Thursday, May 3rd, 1906.

Barrett, Ernest, B.Sc.,
56, Elswick Road, Lewisham, S.E.

Schoolmaster. Three years' study of Chemistry at University College, London, under Sir William Ramsay. Took the B.Sc. degree of London University with 2nd class honours in Chemistry in Oct., 1905. Now engaged in research work under Dr. Lapworth at Goldsmiths' College, New Cross.

J. Norman Collie. Samuel Smiles.
Edward C. Cyril Baly. Arthur Lapworth.
N. T. M. Wilsmore.

Beckett, Richard Henry,
Inval, Haslemere, Surrey.

Professor of Chemistry, Nagpur, and Government Chemist to the Central Provinces, India. Obtained degree of B.Sc. (Lond.), with First Class Honours in Chemistry. Teaching Associate of the Royal College of Science in Chemistry. Two years assisted in teaching Chemistry in the laboratories of the Royal College of Science.

William A. Tilden. Chapman Jones.
M. O. Forster. James C. Philip.
G. T. Morgan.

Birt, Roderick Harold Capper,
54, Shooters Hill Road, Blackheath, S.E.

Appointed to post as Science Master at Radley College from January next. B.A. (Oxon.), 2nd Class Final Honours, School of Chemistry, 1905.

Wm. Odling. W. W. Fisher.
H. B. Baker. D. H. Nagel.
Allan F. Walden. Leonard G. Killby.,

Chamberlain, Percy Garratt,
3, Market Place, Rugby.
Analytical Chemist. 2nd Class Natural Sciences Tripos, 1902 (Part I); Caius College, Cambridge, B.A., 1902, M.A., 1906. Studied Analytical Chemistry under Prof. Fresenius at Wiesbaden, 1902—1903.

M. M. Pattison Muir. R. S. Morrell.
S. Ruhemann. G. Stallard.
A. G. Chamberlain.

Chrystall, Edwin Rodney,
Forest Villa, Prince's Road, Buckhurst Hill, Essex.
Student of Chemistry at University College for 2½ years.

William Ramsay. N. T. M. Wilsmore.
Samuel Smiles. J. Norman Collie.
Edward C. Cyril Baly. J. K. H. Inglis.

Cooper, Herbert Reginald,
Redington, Northwood, R.S.O.
Student at University College. 3½ years in Sir W. Ramsay's Laboratory at University College, London.

William Ramsay. N. T. M. Wilsmore.
J. Norman Collie. Edward C. Cyril Baly.
Samuel Smiles.

Davidson, Charles,
37, Herriot St., Pollokshields, Glasgow.
Analytical Chemist. Chief Chemist with Messrs. Alex. Cross and Sons, Ltd., Glasgow (Manufacturers of Vitriol, Chemical Fertilisers, &c.); author of papers on "Estimation of Nitric Nitrogen" and "Mechanical Calculation of Weight of Vitriol in Chambers" (in "Chemical News"); Member of Society of Chemical Industry.

Alexander M. Forrester. W. S. Curphey.
Thomas Taylor. A. M. Neilson.
John Wm. Biggart.

Dickson, William,
Branksome, Bridge of Weir.
Analytical Chemist. Two years as pupil and one as assistant with R. R. Tatlock and Thomson, Public Analysts; 3 sessions under Profs. Henderson and Gray in Glasgow Technical College; 2 years in Public Works Laboratories; at present engaged in chemical research (Pharmaceutical).

Thomas Gray. R. T. Thomson.
G. G. Henderson. James McLeod.
R. R. Tatlock. *Horatio Ballantyne.*

Duncan, Robert K.,

Present address: c/o Harper & Brothers, 45, Albemarle Street, W. Permanent address: University of Kansas, U.S.A.

Professor of Chemistry, University of Kansas, U.S.A. Author of *The New Knowledge* and of several contributions to scientific journals. Graduate of the University of Toronto, with first-class honours. Fellow of Clark University, Worcester, Mass., U.S.A. Professor in Washington and Jefferson College. Just appointed Professor in the Univ. of Kansas.

William Ramsay. F. N. A. Fleischmann.
J. Norman Collie. G. Carey Foster.

Edward C. Cyril Baly.

Feilmann, Ernest,

2A, Dartmouth Road, Brondesbury, London, N.W.

Chemist. B.Sc. (Lond.), Ph.D., F.I.C.; late 1851 Research Scholar. 10 months research chemist with Messrs. Levinstein, Ltd., Manchester. 4 years research chemist with "The Clayton Aniline Co., Ltd.," Manchester. 1½ years works chemist with Messrs. Brooke, Simpson, and Spiller, Ltd., London. Joint paper on "A Taint in Milk," with J. Golding, *J. Soc. Chem. Ind.*, 1905.

Frank Clowes. Frank Evershed.
C. F. Cross. E. T. Shelbourne.

Edward Bevan.

Foucar, James Louis,

20, St. John's Park, Blackheath, London, S.E.

Chemist. Bachelor of Science, London University, Honours in Chemistry, qualified for Honours in Experimental Physics and Geology, an earnest student of science in general and of chemistry in particular.

Rudolph Messel. Bernard Dyer.
Alfred Gordon Salamon. Alex. McKenzie.
Otto Hehner. O. Silberrad.

H. F. C. Goltz.

Foy, O. Bertram,

16, Burlington Road, Dublin.

Prof. of Experimental Science, H.M. Training College for Teachers, Drumcondra, Dublin. Have been for ten years principal Lecturer and Demonstrator in Chemistry, City of Dublin Technical Schools. Examiner in Chemistry to the Board of Intermediate Education and to the Department of Technical Instruction for Ireland for over five years. Author of: "Elements of Natural Philosophy," edited by

T. A. Finlay, S.J.M.A., F.R.U.I.; "The Balance, its Construction and Use," pamphlet issued by the Board of Technical Instruction, &c.

Edmund M. Rich. Wm. J. Wren.
A. O'Farrelly. *J. Hawthorne.*
Sydney Young.

Gardner, Edward,
70, Parliament Hill Mansions, Highgate Road, N.W.

Analytical Chemist and Metallurgist. I was educated at Tonbridge School and Finsbury Technical College. Since 1895, I have been with Messrs. Johnson and Matthey, Hatton Garden, as Chemist and Analyst.

George Matthey. R. Meldola.
John S. Sellon. C. H. Desch.
Francis H. Carr.

Garvey, Richard Godfrey Hamilton,
25, Park Mansions, Battersea.

Mining Engineer. Mining Engineer engaged on water-softening and purifying, metallurgy and assaying. Four years student of Chemistry at Battersea Polytechnic.

John Wilson. J. L. White.
J. Hart-Smith. S. I. Crookes.
H. W. Coupe-Annable.

Hall, Richard John,
"Sandycroft," Serpentine Rd., Egremont, Liverpool.

Science Teacher, Wallasey Grammar School and Technical Classes. M.Sc., Honours School of Chemistry, Victoria University. A.I.C. (Branch "D"—Organic Chemistry).

J. Parry Laws. Sydney D. Stennitt.
Rudolf Lessing. Herbert Henstock.
J. W. Kynaston.

Hills, James Stuart,
225, Oxford Street, W.

Pharmaceutical and Analytical Chemist. Associate of the Institute of Chemistry. Pharmaceutical Chemist. Salters' Research Fellow (Chemistry), 1903—1905. Original work: "Linin" [J.C.S., 87, 327], in conjunction with Prof. W. Palmer Wynne.

W. Palmer Wynne. John M. Thomson.
J. Norman Collie. Herbert Jackson,
Arthur W. Crossley.

Lattey, William Tabor,

Corpus Christi College, Cambridge.

Undergraduate.

R. T. Lattey. L. C. F. Oldfield.
H. B. Baker. H. O. Jones.
W. J. Sell.

McCombie, Hamilton,

The University, Birmingham.

Lecturer and Demonstrator in Chemistry. M.A. (Aberd.), A.R.C.Sc. (Lond.), A.I.C., B.Sc. (Lond.), Ph.D. (Strass.).

F. R. Japp. James C. Philip.
William A. Tilden. Percy F. Frankland.
M. O. Forster. Alex. Findlay.
G. T. Morgan. *Chapman Jones.*

Murray, Thomas Jenkins,

The University, Birmingham.

Lecturer and Demonstrator in Chemistry, University of Birmingham. Ph.D. (Leipzig), formerly Lecturer and Demonstrator in Chemistry at the Glasgow and West of Scotland Technical College.

G. G. Henderson. Percy F. Frankland.
Thomas Gray. Alex. Findlay.
J. K. H. Inglis.

Oliver, Edgar Gall,

Chigwell School, Essex.

Science Master. M.A. (Cantab.). Foundation Scholar and Prizeman of Downing College, Cambridge. Now Science Master at Chigwell and am desirous of keeping in touch with Chemical Progress.

H. Jackson. T. Luxton.
Eustace Coddington. *Charles T. Heycock.*
V. Seymour Bryant. *T. A. Nightscales.*

Ormerod, Ernest,

8, Leopold Road, Wimbledon, S.W.

Research Chemist. Salters' Co.'s Research Fellow at the Centra Technical College, London. Graduated B.Sc. (Vict.), 1901, M.Sc. (Vict.), 1903, Ph.D. (Bâle), 1905. Have held the Levenstein Research Exhibition at Owens College and the Priestley Research Scholarship at Birmingham University. Five years' research work under Professors

Perkin, Frankland, and Bamberger. Late private assistant to Prof. Bamberger at Zürich.

Henry E. Armstrong. Robert J. Caldwell.
Gerald T. Moody. William Robertson.
William A. Davis. Edward Horton.
J. H. Johnston.

Richardson, Lawrence George,
14, Ashgrove, Horton, Bradford.

Analytical, Consulting, and Dyer's Chemist. Student at Bradford Technical College from January, 1899, to July, 1901. Private Assistant to Prof. W. M. Gardner from July, 1901, to December, 1901. Chemist at Bowling Dyeworks (Edwd. Ripley & Son, Ltd.), from 1902 to December, 1905.

Walter M. Gardner. Joseph R. Denison.
A. B. Knaggs. Thorp Whitaker.
B. North.

Scouller, Walter Daly,
7, Stamp Office Place, Wakefield.

Chemist in the West Riding of Yorkshire Rivers Board Laboratory; studied science and industrial chemistry at the Yorkshire College (now University of Leeds), 1896—1900. Graduated B.Sc. (Vict.) in 1899. Since 1900, chemist in the West Riding Rivers Board Laboratory.

Arthur Smithells. C. E. Whiteley.
J. B. Cohen. W. Lowson.
H. R. Procter. H. T. Calvert.

Sommerville David,
31, Manor House, Marylebone.

B.A. (Chemistry and Physiol.), M.D., &c. Lecturer in Public Health, King's College, London. Late Demonstrator of Physiology, St. Thomas's Hosp. Med. Schl., and Demonstrator of Toxicology, King's College, London. Physician. Author of Practical Sanitary Science (a Handbook for the Public Health Laboratory). Author of various papers on Sewage, Foods, Standardisation of Disinfectants, &c.

R. Meldola. Patrick H. Kirkaldy.
Rudolf Lessing. John M. Thomson.
Herbert Jackson. D. Northall Laurie.

Spencer, James Frederick,
134, Rice Lane, Walton, Liverpool.

B.Sc. (Vict.), M.Sc. (L'pool), Ph.D. (Breslau). Have published in the *Society's Journal*, *Zeitschrift für Anorganische Chemie*, and *Zeit-*

schrift für Elektrochemie, on Pyridine and Furfurol compounds, and several papers on Thallium and on Amalgams.

William Ramsay. N. T. M. Wilsmore.
J. Norman Collie. Samuel Smiles.
Edward C. Cyril Baly. W. Lester Alton.

Sproxton, Foster,

Uplands, Alexandra Park Road, Wood Green, N.

Research Student. B.Sc. London (Honours Chemistry), 1905. Research Student at University College.

F. N. A. Fleischmann. Edward C. Cyril Baly.
Samuel Smiles. A. W. Stewart.
W. B. Tuck.

Storey, Francis W.,

42, Ellerdale Street, Lewisham, S.E.

Teacher. Has obtained his B.Sc. degree of London University in 1905; worked for three years in the chemical laboratories of University College, London, at Analytical Chemistry; is training for a teacher of science.

William Ramsay. N. T. M. Wilsmore.
J. Norman Collie. Edward C. Cyril Baly.
W. Lester Alton.

Tempany, Harold Augustine,

St. Johns, Antigua, B.W.I.

Assistant Govt. Analyst for Leeward Islands. B.Sc. London. Associate Institute Chemistry. Studied at University College, London. Formerly second assistant chemist to Messrs. Gorton Hill & Co. Part author of papers on "Inversion of Cane Sugar in presence of Milk Constituents" and "The Polarimetric Determination of Sucrose."

Francis Watts. W. Lester Alton.
Leonard Temple Thorne. Herbert Jackson.
William Ramsay. *E. Haynes Jeffers.*
J. Norman Collie.

Turner, George Augustus,

"Alma House," Strandtown, Belfast.

Chemist. At the South London School of Pharmacy from January 1902 till October 1903. Member of the Pharmaceutical Society of Great Britain and also the Assistant's qualification of the Pharmaceutical

Society of Ireland. Is desirous of coming into closer contact with pure Chemistry and its progress.

A. H. M. Muter. Will. F. Mawer.
Robert Barklie. A. Percy Hoskins.
J. W. Epps. John H. B. Wigginton.

John Muter.

Watson, John Adam,

8, Powis Gardens, Notting Hill, W.

At present a Student at the Central Technical College, engaged in research work under Professor H. E. Armstrong.

H. E. Armstrong. William A. Davis.
Gerald T. Moody. William Robertson.
T. Martin Lowry. Edward Horton.

West, John Henry,

11, Sydney St., Chelsea, S.W.

Chief Chemist to the Kennicott Water Softener Co., 29, Gt. St. Helens, E.C. Associate of the City and Guilds Institute in the Department of Applied Chemistry; Joint author with Dr. T. M. Lowry of paper on "Persulphuric Acids," published in *Proc. Chem. Soc.*

Henry E. Armstrong. T. Martin Lowry.
F. R. Mallet. Gerald T. Moody.
William A. Davis. *Robert J. Caldwell.*

William Robertson.

Wiffen, Henry John,

17, Albany Road, Manor Park, E.

Manufacturing and Analytical Chemist. Certificates from the City and Guilds, Organic and Inorganic. Five years Assistant Chemist, Great Eastern Railway Stores Laboratory. Chemist for six years with Messrs. Herring, Giles, & Co., Stratford, E.

D. G. Riddick. E. Haynes Jeffers.
T. FitzGibbon. *Geo. Patterson.*

L. T. Thorne.

Wyatt-Edgell, Cecil,

Cowrey Place, Exeter.

Chief Science Master, High Sch., Newcastle, Staffs. 2nd Cl. Honours Chem. Finals (Oxf. Univ.), 1904.

H. B. Baker. N. V. Sidgwick.
W. W. Fisher. Leonard G. Killby.
Allan F. Walden. *A. Angel.*

The following Certificates were authorised for presentation to ballot by the Council under Bye-Law I (3):—

Gupta, Hem Chandra Dutt,
"Guptanibar," Krishnagar (Dist. Nadia), Bengal.

Professor of Chemistry, Tej Narayau Jubilee College, Bhagalpur, Bengal. Studied Chemistry for some 3 years at the Presidency College, Calcutta; took the degree of M.A. of the Calcutta University in Chemistry. Professor of Chemistry in the T. N. Jubilee College, Bhagalpur, Bengal.

J. B. Bhaduri. P. C. Rây.
J. Sen.

Mukerjee, Ram Chandra, B.A.,
Jaipur, Rajputana, India.

Professor of Chemistry, Maharaja's College, Jaipur. Has studied Chemistry for several years and is at present employed as Professor of Chemistry, Maharaja's College, Jaipur, where he has to teach Theoretical and Analytical Chemistry.

A. Sanyal. *Gopal Ch. Banerjee.*

R. CLAY AND SONS, LTD. BREAD ST. HILL E.C. AND BUNGAY SUFFOLK.

Issued 14/5/06

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 309.

Thursday, May 3rd, 1906, at 8.30 p.m. Professor H. E. ARMSTRONG, F.R.S., Past-President, in the Chair.

Messrs. H. C. Irving and W. H. Glover were formally admitted Fellows of the Society.

The CHAIRMAN gave expression to the sense of loss sustained by the Chemical Society in the death of Professor Pierre Curie, which followed an accident on April 19th. The meeting endorsed the letter of condolence addressed by the President to Mme. Marie Curie, an Honorary and Foreign Member of the Society.

Certificates were read for the first time in favour of Messrs. :

Arthur John Berry, 5, University Gardens, Glasgow.
William John Bowis, Ph.D., 97, North Road, West Bridgford, Notts.
Harold Calam, B.Sc., 71, Cemetery Road, Beeston Hill, Leeds.
John Denton, Horton Villa, Bradford.
Bertie James Eaton, Kuala Lumpar, Federated Malay States.
Arthur Burton Shepherd, B.Sc., 18, Stafford Street, Hull.
Fred Smith, Cliff House, Bruntcliffe, near Leeds.
Henry Wren, 22, Stapleton Hall Road, Stroud Green, N.
George Young, B.A., B.Sc., 38, Havelock Street, Sheffield.

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected:

Ernest Barrett, B.Sc.
Richard Henry Beckett, B.Sc.
Roderick Harold Capper Birt, B.A.
Percy Garratt Chamberlain, M.A.
Edwin Rodney Chrystall.
Herbert Reginald Cooper.
Charles Davidson.
William Dickson.
Robert K. Duncan.
Ernest Feilmann, B.Sc., Ph.D.
James Louis Foucar, B.Sc.
P. Bertram Foy.
Edward Gardner.
Richard Godfrey Hamilton Garvey.
Hem Chandra Dutt Gupta, M.A.
Richard John Hall, M.Sc.
James Stuart Hills.
William Tabor Lattey.
Hamilton McCombie, M.A., B.Sc., Ph.D.
Ram Chandra Mukerjee, B.A.
Thomas Jenkins Murray, Ph.D.
Edgar Gale Oliver, M.A.
Ernest Ormerod, M.Sc., Ph.D.
Lawrence George Richardson.
Walter Daly Scouller, B.Sc.
David Sommerville, B.A., M.D.
James Frederick Spencer, M.Sc., Ph.D.
Foster Sproxton, B.Sc.
Francis W. Storey, B.Sc.
Harold Augustine Tempany, B.Sc.
George Augustus Turner.
John Adam Watson.
John Henry West.
Henry John Wiffen.
Cecil Wyatt-Edgell, B.A.

Of the following papers, those marked * were read:

***87. "The relation between absorption spectra and chemical constitution. Part V. The *iso*nitroso-compounds." By Edward Charles Cyril Baly, Effie Gwendoline Marsden, and Alfred Walter Stewart.**

In the previous papers it was shown that when two carbonyl groups are adjacent to one another in a compound, the process of isorropesis is set up between the residual affinities of the oxygen atoms with the result that an absorption band is produced in the visible blue region of the spectrum and the compounds are coloured yellow. The principle was extended to the quinones and to the nitrophenols and nitroanilines. A similar condition exists in the *iso*nitroso-compounds, and in the present paper the yellow colour of these substances in alkaline solution is explained. From observations of the absorption spectra of several *iso*nitroso-compounds in neutral and alkaline solution, it is found that the free substances most probably have the constitution $\begin{matrix} R\cdot C:O \\ | \\ R\cdot \overset{*}{C}H\cdot NO, \end{matrix}$ but in presence of sodium hydroxide the hydrogen atom marked with a star is replaced by sodium and becomes labile, so that a tautomeric process occurs, thus:

$$\begin{array}{l} R\cdot C{:}O \\ R\cdot CNa\cdot NO \end{array} \rightleftarrows \begin{array}{l} R\cdot C{:}O \\ R\cdot C{:}NONa \end{array}$$

a. *b.*

Isorropesis then takes place between the >C:O and >C:N– groups, the tautomeric process being the actuating mechanism. The compounds are therefore yellow in alkaline solution, owing to the presence of an absorption band in the visible blue region of the spectrum, which is due to the isorropesis. There is thus complete analogy between the *iso*nitroso-bodies and quinonemonoxime. An analogous condition is shown to exist in the case of *iso*nitrosocamphor.

Discussion.

Dr. Hewitt drew attention to the way in which Mr. Baly had represented both nitroso- and *iso*nitroso-camphor as equilibrium mixtures, one particular configuration of the molecule being common to both substances. If *X* be in equilibrium with *Y*, and *Y* in turn with *Z*, then *X* and *Z* must also be in equilibrium, and it should be impossible to isolate two different substances, one containing molecules of configurations *X* and *Y* and the other molecules of configurations *Y* and *Z* in the case of rapid velocities of transformation.

Dr. Lowry considered it very improbable that any of the colourless compounds to which Mr. Baly had referred possessed the true nitroso-formula >CH·NO, since this group usually produces a blue or green coloration. He was surprised that no reference had been made to Beckmann's isoxime-formula, $>C<\begin{matrix} NH \\ O \end{matrix}$; nitrogen-ethers derived from the isoximes had been prepared in several cases, and nearly all the colour changes to which Mr. Baly had referred might be explained by the conversion of a coloured oxime into a colourless isoxime and *vice versâ* (compare *B.A. Report*, Cambridge, 1904, p. 222). He strongly objected to the application of the term "tautomerism" to substances such as *iso*nitrosocamphor and ethyl acetoacetate; these substances were certainly not "tautomeric" in the sense of Laar's hypothesis, and it would be preferable to describe them in accordance with their actual behaviour as examples of labile or dynamic isomerism.

Mr. Wm. Robertson asked if Mr. Baly had examined the absorption spectra of the simple oximes. From the physical evidence, such as refractive indices, it would appear that the oximes and their salts were identical in structure, whereas in the case of the *iso*nitroso-compounds a very different condition of affairs obtained. With regard to the

*iso*nitrosocamphors, he was of opinion that the stable *iso*nitrosocamphor and its oxygen ethers contain the grouping $<\begin{matrix}\text{C}\cdot\text{N}\cdot\text{OR}\\ \|\\ \text{C}\cdot\text{O}\end{matrix}$, and that the salts derived from the unstable isomeride are represented by the grouping $<\begin{matrix}\text{C:NOM}\\ |\\ \text{C:O}\end{matrix}$.

Dr. FORSTER stated that without having had an opportunity of examining the detailed communication, he had some difficulty in dealing with Mr. Baly's references to the views he had from time to time expressed regarding the constitution of *iso*nitrosocamphor, but it seemed to him that the most important observation on that point which Mr. Baly and his colleagues had brought forward was the close similarity between the absorption spectra of the stable *iso*nitrosocamphor and its *O*-alkyl ethers. Experiments of a merely chemical nature had made it clear that these ethers and the colourless benzoyl derivative are not compounds of the type $C_8H_{14}<\begin{matrix}\text{C:N}\cdot\text{OX}\\ |\\ \text{C:O}\end{matrix}$, and the obvious inference is that the stable *iso*nitrosocamphor likewise belongs to a different class. Nevertheless, he was quite unable to accept the explanation of the authors, who, he understood, represented the stable modification as an equilibrium mixture,

$$C_8H_{14}<\begin{matrix}\text{C:O}\\ |\\ \text{CH}\cdot\text{NO}\end{matrix} \rightleftarrows C_8H_{14}<\begin{matrix}\text{C}\cdot\text{OH}\\ \|\\ \text{C}\cdot\text{NO}\end{matrix},$$

a system which should surely display some characteristics of a true nitroso-compound. If the stereochemical theory applied to *iso*nitrosocamphor had to be abandoned, as to which the speaker was not completely convinced, a more satisfactory explanation of the difference between the two modifications of *iso*nitrosocamphor lay in the expression $C_8H_{14}<\begin{matrix}\text{C}=\!=\text{N}\\ |\\ \text{C(OH)}\cdot\text{O}\end{matrix}$ (*pseudo*-form), which accounted for the readiness with which α-camphornitrilic acid arose from the colourless derivatives on hydrolysis. As an alternative to this might be offered the similar formula $C_8H_{14}<\begin{matrix}\text{C}-\text{N}\cdot\text{OH}\\ |\quad\|\\ \text{C}-\text{O}\end{matrix}$, but, except in so far as it presented a smoother transposition from the unstable form

$$C_8H_{14}<\begin{matrix}\text{C:N}\cdot\text{OH}\\ |\\ \text{C:O}\end{matrix},$$

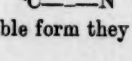
it possessed no great advantage over the *pseudo*-form, although, in the speaker's opinion, certainly preferable to the isoxime constitution.

The CHAIRMAN congratulated the meeting on the fact that the paper had been so well discussed, and subjected to the proper criticism to which all papers presented to the Society should be open; it was

clearly the general opinion that the conclusions arrived at were unsound. He could not agree that the word "isorropesis" coined by Mr. Baly was a good one, and he protested against its introduction; neither was it necessary, nor did it express the conception which had been brought forward. Apparently it indicated a process in which a state of equipoise or equilibrium was arrived at: to express which no new word was required; in reality, the idea put forward was that the production of absorption bands was due to a wobble or metamorphosis, to change of form: which also could be expressed without a new word. There was a growing practice among scientific workers, whenever a vague new conception was arrived at, to wrap it up in a new word which few could understand. He desired, with whatever authority the Chair gave, to protest in the most emphatic manner possible against the practice. He agreed with previous speakers that nitroso-formulæ such as were put forward, could not be used for the colourless compounds under consideration: substances so constituted would be highly coloured. Mr. Baly objected to the interpretation put upon the term isorropesis, and denied that it meant wobble generally; it appeared that he limited it strictly to the wobble involved in the passage from the ketonic to the linked oxygen form of quinone.

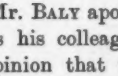
Mr. Baly said, in reply to Dr. Hewitt, that the existence of one configuration being common to both processes was no objection. Two possibilities of labile isomerism exist in *iso*nitrosocamphor, and one of these they connected with the unstable variety and the other with the stable variety. The existence of a common configuration accounts for the ease with which unstable *iso*nitrosocamphor passes over into the stable form.

In reply to Dr. Lowry, he thought that there was no direct evidence that the group >CH·NO, as suggested, possessed a blue or green colour. The isoxime formula did not seem capable of explaining the absorption curves obtained with the *iso*nitroso-compounds. In alkaline solution these bodies all show a strong absorption band in the ultra-violet analogous to ethyl acetoacetate in alkaline solution. Such a band as this does not seem capable of explanation by an equilibrium between the isoxime and oxime form; it must be due to the same type of labile isomerism as is occurring in ethyl acetoacetate.

In reply to Mr. Robertson, the absorption curves show that the stable form of *iso*nitrosocamphor in neutral solution possesses the same configuration as Dr. Forster's oxygen alkyl ethers. They therefore attributed the formula  to this substance. To the coloured derivatives of the unstable form they attributed the formula

, but if the unstable form were colourless it could not have the formula .

In reply to Dr. Forster, Mr. BALY apologised for not making himself clear upon the suggestions his colleagues and he brought forward. They were firmly of the opinion that the stable form of *iso*nitroso-camphor in neutral solution was Dr. Forster's own pseudo-form,

 ,

but that in alkaline solution the ring was broken and that a process of labile isomerism was set up which could be best expressed by saying there was equilibrium between

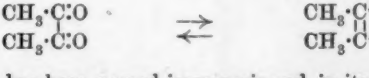
a. *b.*

the colour in alkaline solution being due to the parallel linking in *a*. Similarly, in the unstable form their view was that in alkaline solution the labile tautomerism could be best expressed by

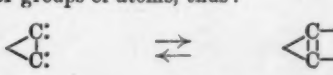
b. *c.*

the colour was due to the isorropesis occurring with form *c*. It was difficult to give a formula to the unstable form in neutral solution, as its colour was not absolutely known.

There seemed to be confusion as to the meaning of the term isorropesis and he would like to state what the process consists in. The simplest case is that of diacetyl, in which compound the residual affinities on the ketonic oxygen atoms disturb one another, with the result that an oscillation is set up which can, perhaps, be graphically expressed :

 .

This process has been named isorropesis and, in its broadest sense, it means an oscillation between the residual affinities of two or more adjacent atoms or groups of atoms, thus :

 ,

or

The process might also be looked on as the result of the mutual interference between two systems, each possessing possibilities of labile isomerism, as, for example, the two $CH_3 \cdot CO$ groups in diacetyl.

***88. "The residual affinity of coumarin as shown by the formation of oxonium salts." By Gilbert Thomas Morgan and Frances Mary Gore Micklethwait.**

Coumarin dissolves much more readily in concentrated hydrochloric acid than in water, and the strongly acid solution, when treated with excess of chloroplatinic acid, yields a yellow, crystalline *platinichloride*, $4C_9H_6O_2,H_2PtCl_6,4H_2O$, which is dissociated into its generators by water. 6-Aminocoumarin, ethyl-6-aminocoumarin, dimethyl-6-aminocoumarin, and the corresponding quaternary base, like other aromatic amines, all yield platinichlorides, platinibromides, and aurichlorides of the normal type, but the acyl derivatives of 6-aminocoumarin, in which the salt-forming power of the nitrogen atom is largely destroyed, resemble coumarin itself in giving rise to platinichlorides containing a greater proportion of the organic constituent. *Acetyl-6-aminocoumarin platinichloride* has a composition approximating to the formula

$$4(C_7H_5O_2 \cdot NH \cdot CO \cdot CH_3),H_2PtCl_6,4H_2O.$$

Coumarin dissolves readily in warm fuming hydriodic acid containing free iodine, and from the dark brown solution, dark bronzy-green masses or well-defined needles separate, depending on the concentration; the product, which can be recrystallised from concentrated hydriodic acid, has the composition of a *hydriodide periodide*, $4C_9H_6O_2,HI,I_8$.

The formation of these salt-like additive compounds of coumarin agrees with the results of earlier investigators. Ebert found that this lactone yielded an extremely unstable hydrobromide (*Annalen*, 1884, **226**, 347), whilst W. H. Perkin, sen., described a dichloride and dibromide (*Annalen*, 1871, **157**, 116). Moreover, coumarin exhibits an amphoteric character in combining also with metallic oxides and hydroxides.

DISCUSSION.

Dr. CAIN referred to his paper on "The Constitution of the Ammonium Compounds" (*Mem. Manchester Phil. Soc.*, 1904, **48**, iii,

No. 14), in which he had suggested formulæ for the so-called molecular compounds, similar to those now brought forward by Dr. Morgan. He did not believe in Werner's theory of "Haupt Valenz" and "Neben Valenz" as applied to the ammonium compounds, but was of the opinion that a satisfactory explanation was given by assuming the presence of triad halogen and tetrad oxygen.

Dr. HEWITT remarked that the formation of oxonium salts frequently coincided with the occurrence of another oxygen atom in the molecule, in addition to the salt-forming oxonium oxygen atom: not only in the case of pyrones and coumarins, but also with xanthone and fluorane derivatives. Dr. Cain's formulation of ammonium chloride was open to the objection that it seemed incompatible with the known ionisation of ammonium salts in aqueous solution: a difficulty in no way diminished when one applied corresponding formulæ to the tetra-alkylammonium bases and their salts.

Dr. MORGAN, in reply to a question from Mr. F. H. CARR, stated that they had made many attempts to combine coumarin with metallic salts such as mercuric iodide, but without success.

89. "Brazilin and hæmatoxylin. Part VII. Some derivatives of brazilein." By Paul Engels and William Henry Perkin, jun.

Brazilein, $C_{16}H_{12}O_5$, is the colouring matter which is produced when brazilin, $C_{16}H_{14}O_5$, is oxidised in alkaline solution by means of air.

When brazilein is treated with a large excess of methyl sulphate and caustic potash, it is converted into *trimethylbrazilein*,

$$C_{16}H_9(OMe)_3O_5,$$

the formula of which was controlled by repeated analysis and the determination of the methoxy-groups by Zeisel's method.

This new orange-yellow, crystalline substance separates from solvents in two modifications, which melt at 160° and 178° respectively. It combines with formic acid, yielding *trimethylbrazilein formic acid*, which crystallises in brilliant garnet-coloured prisms, melts at 143°, and is decomposed into its components by treatment with alcohol. Trimethylbrazilein dissolves in concentrated sulphuric acid, yielding a crimson solution which soon becomes orange and, when poured into water, deposits a brilliant vermilion, crystalline precipitate which appears to be *trimethylisobrazilein sulphate* (compare J. J. Hummel and A. G. Perkin, Trans., 1882, 41, 9).

When trimethylbrazilein is left in contact with an alcoholic solution of hydroxylamine, it yields *trimethylbrazilein hydroxylamine*,

$$C_{16}H_9(OMe)_3O_5,NH_2{\cdot}OH,$$

an almost colourless, crystalline substance which melts at about 155°

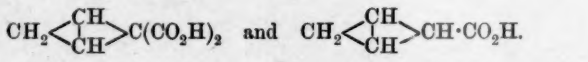
with decomposition. This substance dissolves in dilute alkalis with a yellow colour, and is decomposed, on standing, into a neutral substance of melting point 177° and trimethylbrazilein. It is also decomposed by boiling glacial acetic acid, and the solution, on cooling, deposits crystals of trimethylbrazilein.

The authors wish to reserve these new compounds for further investigation.

90. "The action of tribromopropane on the sodium derivative of ethyl malonate." By William Henry Perkin, jun., and John Lionel Simonsen.

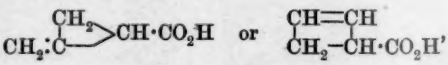
In a previous communication (Proc., 1905, **21**, 256), it was shown that tribromopropane, $CH_2Br{\cdot}CHBr{\cdot}CH_2Br$, reacts with the sodium derivative of ethyl malonate with formation of an ester $C_{10}H_{15}O_2Br$.

This ester, when treated with alcoholic potash, yields an acid, $C_4H_4(CO_2H)_2$, which is decomposed on heating, with elimination of carbon dioxide and formation of the corresponding monobasic acid, $C_4H_5(CO_2H)$. Since these two acids do not decolorise bromine, are very slowly oxidised by permanganate, and are not affected by boiling with sodium amalgam, it was suggested that they are probably *dicyclobutane* derivatives of the formulæ



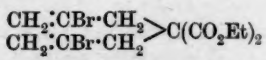
These acids have now been prepared in considerable quantities, and the determination of the magnetic rotation of their esters has proved conclusively that they cannot have the above formulæ, but that they must be unsaturated closed chain compounds.

From a careful investigation of their behaviour, the authors incline to the view that the monobasic acid must be represented by one of the constitutional formulæ



but such formulæ are, obviously, very difficult to establish.

Besides the bromo-ester mentioned above, a second *bromo-ester*, $C_{13}H_{18}O_4Br_2$, is formed during the action of tribromopropane on the sodium derivative of ethyl malonate; this distils at 191° (11 mm.), and has either the constitution



or some constitution closely allied to this.

When digested with alcoholic potash, it yields an acid of melting point 47°, which closely resembles the *pseudo*phenylacetic acids, and probably has the constitution

$$CH_2{:}C(CH{:}CH{\cdot}CH)-CH_2-C(=O){\cdot}CO_2H$$

This interesting acid instantly decolorises permanganate, and when boiled with water or mineral acids, or treated with acetic or hydrobromic acid in the cold, is converted quantitatively by molecular rearrangement into *m*-toluic acid (m. p. 110°):

$$CH_3{\cdot}C(CH{:}CH{\cdot}CH){:}CH-C(=O){\cdot}CO_2H$$

For this reason the acid of melting point 47° has been named *pseudo*-m-*toluic acid.*

The further investigation of these new compounds is in progress.

91. "Pipitzahoic acid." By James McConnell Sanders.

An investigation of this substance was made by the author at the instance of the Mexican Government, with the object of correcting, if possible, the discrepancies which exist in the literature. Considerable attention is being attracted by this substance owing to its peculiar and valuable properties as a non-toxic purgative. The author describes the method of extraction from the Pipitzahoac root and the properties of the purified acid.

The formulæ of Weld ($C_{20}H_{20}O_6$) and Mylius ($C_{15}H_{20}O_3$) are rejected, the author considering that its composition is best represented by the formula $C_{10}H_{14}O_2$, it being thus isomeric with camphorquinone and similar to, although not identical with, the *iso*camphorquinone discovered by Manasse and formulated by Bredt as $\Delta^{1-4}(8)$-terpadienol (*Ber.*, 1902, **36**, 3829—3843). Pipitzahoic acid is obtained in golden-yellow scales or orange crystals and melts at 104—105°; by prolonged heating above its melting point it loses carbon monoxide and carbon dioxide, giving at first a lemon-yellow sublimate, which melts at 88—89°, and finally a beautifully crystalline, colourless sublimate, which is insoluble in water, but soluble in most organic solvents. This *compound*, $C_{11}H_{14}O_2$, crystallises from acetone or benzene in glistening prisms melting at 140°, and having an odour of camphor. Its solutions are optically active, a 2 per cent. solution in alcohol having $[\alpha]_D = 77{\cdot}9°$ at 25°; it does not react with hydroxylamine or aniline, but with acetic anhydride forms a *compound*, $C_{41}H_{50}O_{10}$, which crystallises from acetone in square plates melting at

114—115°. Pipitzahoic acid is insoluble in water, but soluble in most organic solvents, its solutions being optically inactive. Its violet alkaline solution yields the unchanged substance on acidifying or by extraction with ether. It has a neutral reaction, does not contain methoxy-groups, and does not combine with sodium bisulphite. On fusion with potash, the acid gives methyl hexylene ketone and butyric acid. It forms an *oxime* (m. p. 153·7°), an aniline *compound* (m. p. 134—135°), and a *dibromide*, which is a yellowish-brown, unstable oil. It is not reduced by sulphurous acid, but easily reduced by zinc dust and acetic acid, and when distilled in a current of hydrogen over zinc pumice gives a readily oxidisable liquid which forms optically inactive fluorescent solutions in chloroform and ether. The reduction product itself is isomeric with benzylidenecamphor, $C_{17}H_{20}O$. Pipitzahoic acid seems to behave as a hydroxy-ketone, forming a resinous acetyl compound and a greenish-brown *copper* derivative, $(C_{10}H_{13}O_2)_2Cu$.

Silk may be dyed an olive-green tint by treating it with a solution of pipitzahoic acid after a preliminary mordanting with copper acetate.

92. "The constitution of the hydroxides and cyanides obtained from acridine, methyl-acridine, and phenanthridine methiodides." By Charles Kenneth Tinkler.

From the results obtained by a study of the ultra-violet absorption spectra of the methiodides, before and after the addition of caustic soda, it is concluded that the hydroxides produced are carbinols and are constituted similarly to the hydro-compounds, as in the cases of cotarnine, hydrastinine, and phenylmethylacridol (Dobbie, Lauder, and Tinkler, *Trans.*, 1903, **83**, 598, Dobbie and Tinkler, *Trans.*, 1904, **85**, 1005, and 1905, **87**, 269).

The cyanide obtained from phenylacridine methiodide (Hantzsch, *Ber.*, 1899, **32**, 3109) gives spectra almost identical with those of hydrophenylacridine, thus affording evidence in support of the constitution $C_6H_4<\begin{matrix}C(C_6H_5)CN\\N(CH_3)\end{matrix}>C_6H_4$ for this substance. A colourless cyanide has been prepared from phenanthridine methiodide. The absorption spectra of the substance agree very closely with those of hydrophenanthridine, and this is only to be explained by adopting the constitution of a *pseudo*-cyanide for this substance,

$$\begin{matrix}C_6H_4\cdot CH\\ C_6H_4\cdot N\cdot CH_3I\end{matrix} \rightarrow \begin{matrix}C_6H_4\cdot CH(CN)\\ C_6H_4\cdot N\cdot CH_3\end{matrix}$$

93. "The constitution of ammonium amalgam."
By Miss Elizabeth Mary Rich and Morris William Travers.

The authors have determined the freezing points of a series of samples of ammonium amalgam, in which the concentration, calculated as grams of ammonium per 100 grams of mercury, varied between 0·0094 and 0·507. The value of the "molecular depression" agrees with that obtained by Tammann for solutions of other metals in mercury, leading to the conclusion that ammonium amalgam is a true solution of ammonium in mercury.

94. "Action of light on potassium ferrocyanide."
By Glyn William Arnold Foster.

When a neutral or alkaline solution of potassium ferrocyanide is exposed to light, ferric hydrate is slowly precipitated; in presence of alkali sulphide, ferrous sulphide is thrown down.

No precipitation takes place if the solutions are protected from light: the action is therefore entirely photochemical. Potassium ferrocyanide is, in solution, dissociated in the usual manner into potassium ions and the complex "ferrocyan" ions $[Fe(CN)_6'''']$: this is in absence of light. On exposure to light, this complex is dissociated into iron ions and cyan ions, and on removing the source of light the complex ferrocyan ion is regenerated. Thus no precipitation of iron can take place in absence of light.

The relations Fe : (CN) were always below the theoretical 1 : 6, and this was found to be due to the oxidation of cyanide under the influence of light to cyanate and polymerides. In presence of alkali sulphide the cyanide is almost entirely converted into sulphocyano-compounds.

The source of light used was a mercury vapour lamp of quartz, made by W. C. Heraeus of Hanau. It was water-cooled, and, using a direct current of 5—6 amperes at 240—250 volts, gave a very intense light, rich in ultra-violet radiation.

95. "Note on the constitution of cellulose."
By Arthur George Green and Arthur George Perkin.

It is generally believed that the highest acetyl derivative of cellulose is a tetra-acetate, $C_6H_6(OAc)_4O$.

Green's formula for cellulose (*Zeit. Farb. Text. Ind.*, 1904, **3**, 97),

$$\begin{array}{l} CH(OH)\cdot CH\text{—}CH(OH) \\ \quad\quad\quad\quad >O \quad >O \\ CH(OH)\cdot CH\text{—}CH_2 \end{array}$$

, contains only three hydroxyl groups and

would therefore yield a *tri*-acetate. As this formula affords a simple and direct explanation of the other reactions of cellulose, a re-examination of the acetate was desirable. Acetyl estimations of the so-called "tetra-acetylcellulose" were therefore made by three different methods: (*a*) Perkin's method (*Trans.*, 1905, **87**, 107); (*b*) alkaline saponification; (*c*) alkaline saponification combined with Perkin's method. In each case the numbers obtained agreed closely with those required for the tri-acetate, $C_6H_7(OAc)_3O_2$.

The highest acetate, therefore, like the highest nitrate and benzoate, corresponds with the presence of three hydroxyl groups in the cellulose molecule.

It is suggested that the above expression represents cellulose in its simplest or unpolymerised form, but that fibre cellulose is a colloidal aggregate of a large number of such simple molecules.

96. "Some new derivatives of pinene." By Frederick Peacock Leach.

When pinene nitrosochloride is treated with potassium cyanate in alcohol at 50—60°, potassium chloride is precipitated, and on pouring the mixture into water a *compound*, $C_{12}H_{17}O_3N_3$, separates, which after crystallisation from alcohol melts at 238—240°. The substance is characterised by its great stability, being dissolved by hot concentrated nitric acid without undergoing change.

On reduction with zinc and acetic acid, carbon dioxide and ammonia are eliminated, the *compound* $C_{11}H_{18}ON_2$ being formed. This melts at 224°, and from its behaviour towards nitrous acid is most probably a ψ-carbamide, giving a well-crystallised *nitroso*-derivative melting at 159°; when the latter is reduced, the corresponding ψ-semicarbazide is formed, yielding a *benzal-ψ-semicarbazone*, $C_{18}H_{23}ON_3$, which melts at 180°. When the compound $C_{12}H_{17}O_3N_3$ is heated with concentrated sulphuric acid, carbon dioxide and ammonia are eliminated, and there is produced a *base*, $C_{10}H_{18}ON_2$, which crystallises in needles and melts at 123—125°: $C_{12}H_{17}O_3N_3 + 2H_2O = C_{10}H_{18}ON_2 + 2CO_2 + NH_3$. This compound is amphoteric, and appears to be an amino-oxime; it is obtainable also from pinene nitrosochloride by the action of ammonia.

97. "Glutaconic and aconitic acids." By Siegfried Ruhemann.

Rogerson and Thorpe show in their papers (Trans., 1905, **87**, 1669, 1685; 1906, **89**, 631) on glutaconic and aconitic acids that they are unacquainted with several of my publications dealing with these acids,

and they misrepresent some of my statements. I feel reluctantly obliged, therefore, to point out their errors.

After having found that ethyl aconitate, on treatment with ammonia, yields citrazinamide (*Ber.*, 1887, **20**, 3366), I applied this reaction to the β-alkyl derivatives of ethyl glutaconate, and thus arrived at the β-alkyl substitution products of 2 : 6-dihydroxypyridine. Thus methyl, ethyl, and benzyl 2 : 6-dihydroxypyridine have been obtained (Trans., 1893, **63**, 259, 874), which are oxidised by ferric chloride to yellow substances. Lately, Rogerson and Thorpe have prepared derivatives of 2 : 6-dihydroxypyridine (Trans., 1905, **87**, 1685) which contain alkyl groups in the γ-position and others with the same groups in the β- and γ-positions, and have pointed out that these derivatives react with ferric chloride in a manner different from the β-substituted 2 : 6-dihydroxypyridines (see Ruhemann, *loc. cit.*), but these chemists appear to be unaware of the fact that I had previously obtained derivatives of 2 : 6-dihydroxypyridine containing alkyl groups in the γ- and $\gamma\beta$-positions by the action of ammonia on the products of the union of ethyl phenylpropiolate with ethyl malonate or its homologues, and that I have also described their reaction with ferric chloride (Trans., 1899, **75**, 245). Again, in recording the properties of the $\alpha\alpha'$-dihydroxypyridines, Rogerson and Thorpe indicate the analogy which exists between these substances and resorcinol, but they seem to have overlooked the fact that I have already recorded this (*Ber.*, 1893, **26**, 1559).

By the action of ethyl sodiocyanoacetate on ethyl oxaloacetate, Rogerson and Thorpe (Trans., 1906, **89**, 640) obtained ethyl α-cyanoaconitate which, under the influence of concentrated sulphuric acid, condenses to ethyl 2 : 6-dihydroxypyridine-4 : 5-dicarboxylate. They further show that, on boiling this ester with alkali, it is transformed into citrazinic acid. They state that ethyl dihydroxycinchomerate had first been prepared by Errera and Perciabosco (*Ber.*, 1901, **34**, 3713), but they have overlooked the fact that Ruhemann and Stapleton (Trans., 1900, **77**, 250) had obtained it a year before by the action of ammonia on ethyl propenetetracarboxylate, and had described its conversion into citrazinic acid.

I am especially surprised that Rogerson and Thorpe should have misunderstood Ruhemann and Orton's statements concerning the configuration of aconitic acid. They say (p. 634) that we assigned to this acid the configuration $\begin{matrix} CO_2H\cdot CH \\ \| \\ CO_2H\cdot CH_2\cdot C\cdot CO_2H \end{matrix}$, "on account of its formation from citrazinamide by the action of caustic potash at 150°, and also owing to the formation of citrazinamide by the action of ammonia on ethyl aconitate." As a matter of fact, the former reaction has never been advanced as a proof of the fumaroid structure. This

was mainly derived from a careful study of the transformations of citrazinamide. I need not here enter into the arguments which support this view, because they are fully discussed in the paper to which Rogerson and Thorpe refer (Ruhemann and Orton, *Ber.*, 1894, **27**, 3449).

The research described in this paper points to the existence of the other possible stereoisomeride, $\begin{matrix} HC\cdot CO_2H \\ \| \\ CO_2H\cdot CH_2\cdot C\cdot CO_2H \end{matrix}$; it was suggested only that the latter is "probably" identical with Baeyer's aceconitic acid (*Annalen*, 1865, **135**, 306), but not put forward as our definite opinion, as Rogerson and Thorpe seem to imagine (Trans., 1906, **89**, 634).

Rogerson and Thorpe arrive at a different conclusion as to the formula of aconitic acid by assigning to it a symmetrical structure, similar to that which they give to glutaconic acid. They support this view by demonstrating the formation of the same methylaconitic acid from both ethyl-α-cyano-α-methylaconitate,

$$CN\cdot CMe(CO_2Et)\cdot C(CO_2Et):CH\cdot(CO_2Et),$$

and ethyl α-cyano-γ-methylaconitate,

$$CN\cdot CH(CO_2Et)\cdot C(CO_2Et):CMe(CO_2Et).$$

The same criticism which Feist and Beyer (*Annalen*, 1906, **345**, 117), who succeeded in proving the existence of both stereoisomeric β-methylglutaconic acids, offer to Rogerson and Thorpe's symmetrical structure of glutaconic acid applies also to the symmetrical structure of aconitic acid. Without entering into further discussion of the conclusions at which these chemists arrive, I will only point out that if their view were correct, the action of ammonia on ethyl aconitate may be expected to yield, besides citrazinamide, a five-membered ring compound, $CONH_2\cdot CH_2\cdot \begin{matrix} CH\cdot CO \\ \| \\ C\text{—}CO \end{matrix} > NH$, but the formation of this compound does not take place.

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in June next. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before Monday, June 4th, 1906.

Those Fellows who received grants in June 1905, or whose grants, allotted in June of previous years, have not been closed, are reminded that reports must be in the hands of the Hon. Secretaries not later than Friday, June 1st, 1906.

CLEVE MEMORIAL LECTURE.

The Cleve Memorial Lecture will be delivered by Professor T. E. Thorpe, C.B., F.R.S., on Thursday, June 21st, 1906, at 8.30 p.m., before the business of the Ordinary Meeting.

At the next Ordinary Meeting, on **Thursday**, May 17th, 1906, at **8.30** p.m., the following papers will be read :

"The relation between absorption spectra and chemical constitution. Part VI. The phenylhydrazones of simple aldehydes and ketones." By E. C. C. Baly and W. B. Tuck.

"Aromatic compounds obtained from the hydroaromatic series. Part II. The action of phosphorus pentachloride on trimethyldihydroresorcin." By A. W. Crossley and J. S. Hills.

"Studies of dynamic isomerism. Part V. Isomeric sulphonic derivatives of camphor." By T. M. Lowry and E. H. Magson.

"The rusting of iron." By J. T. Nance.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 30/5/06

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 310.

Thursday, May 17th, 1906, at 8.30 p.m. Professor R. MELDOLA, F.R.S., President, in the Chair.

Messrs. E. Barrett, E. R. Chrystall, J. L. Foucar, P. H. Marsden, H. Martin, J. T. Nance, W. D. Seaton, W. H. Simmons, D. Sommerville, P. F. Spencer, F. W. Storey, R. W. Tonkin, and J. A. Watson were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.:

Shelton Gottlieb Agar, Panorama House, Guernsey.
Thomas William D. Gregory, 82, Moorland Road, Burslem.
John Gerard Hughes, 2, Canute Road, Southampton.
Ernest Arthur Jenkinson, Dauntsey Agricultural School, West Lavington.
William Rest Mummery, The Firs, Shenfield, Essex.
Arthur Charles Palmer, B.Sc., 17, Wansbeck Gardens, West Hartlepool.
Samuel Shrowder Pickles, B.Sc., The Imperial Institute, S.W.
Willie Macro Seaber, B.Sc., Firdale, Sheen Lane, East Sheen.
James Neil Watts, P.O. Eikenhof, Johannesburg, S. Africa.

Certificates have been authorised by the Council for presentation for ballot under Bye-law I (3) in favour of:

Surendra Prasad Sanyal, M.A., Majhowli Raj, Gorakhpur, U.P., India.

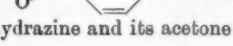
Allan Sime, Kingston, Jamaica.

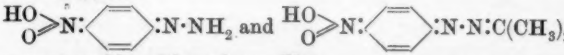
Edward Jocelyn Wortley, Rectory, Half-way Tree, Jamaica.

Of the following papers, those marked * were read:

***98. "The relation between absorption spectra and chemical constitution. Part VI. The phenylhydrazones of simple aldehydes and ketones." By Edward Charles Cyril Baly and William Bradshaw Tuck.**

A spectroscopic investigation of the phenylhydrazones of formaldehyde, acetaldehyde, propylaldehyde, acetone, and diethylketone shows that all these compounds exist in two forms, the true hydrazone and the azo-form, in which the hydrogen atom has wandered from the nitrogen atom to the carbon atom of the aldehyde or ketone residue, thus: $Ph{\cdot}NH{\cdot}N{:}CH{\cdot}CH_3$ and $Ph{\cdot}N{:}N{\cdot}CH_2{\cdot}CH_3$. The azo-form is the more stable, and all the above compounds readily pass over into this form under the influence of light, except formaldehyde phenylhydrazone, which polymerises. All the azo-compounds are strongly coloured, owing to the isorropesis between the unsaturated nitrogen atoms and the benzene nucleus. If the compounds are prepared from *p*-bromophenylhydrazine, the change to the azo-form takes place quite slowly; when aldehydes and ketones are allowed to react with *p*-bromophenylhydrazine, the true hydrazone is always produced first, which is not always the case when phenylhydrazine is used, for in certain instances the azo-compound is obtained at once. As is to be expected, true hydrazones which are perfectly stable are produced by the interaction of aldehydes and ketones with phenylmethylhydrazine.

An investigation into the absorption spectra of the hydrazones of the three isomeric nitrobenzaldehydes shows that the colour of these substances is not due to their existence in the azo-form. It is found, however, that they exist in the quinonoid form and are somewhat similar to the nitrophenols. The formula of the *para*-compound is, in all probability,  . Similarly, in the case of *p*-nitrophenylhydrazine and its acetone derivative, these compounds are quinonoid, thus:



and are comparable with *p*-nitroaniline.

Discussion.

Mr. W. Robertson asked Mr. Baly if he had examined the spectra of the two pure acetaldehydephenylhydrazones individually, inasmuch as the product of melting point 80°, found by Mr. Baly to give rise to the absorption band in the ultra-violet, is far from being a pure substance. It would be of considerable interest to ascertain if this band is also shown by either isomeride in the pure state in neutral solvents.

Dr. Lander asked the authors whether the change of hydrazone to azo-compound was complete, or whether the two substances formed a mixture in equilibrium in solution.

Dr. Hewitt asked Mr. Baly if he had examined any hydrazones obtained from quinolylhydrazines. *Ortho-* and *ana*-quinolylhydrazines were examined some years back by Dufton (*Trans.*, 1891, **59**, 756; 1892, **61**, 782), when it was found that certain of the derived hydrazones, more especially those prepared with *ana*-quinolylhydrazine, exhibited brilliant colours. The author did not, however, suggest for them any other than a hydrazone structure (compare Armstrong, *Trans.*, 1892, **61**, 789).

Mr. Baly said that the two isomerides mentioned by Mr. Robertson would, if present, give identical absorption bands. He hoped to extend the work in very many directions, but had not yet examined the substances mentioned by Dr. Hewitt.

*99. "The rusting of iron." By John Trengove Nance.

It is known that ammonium chloride solution accelerates the rusting of iron. The author finds that interaction takes place with evolution of hydrogen and liberation of ammonia; iron passes into solution in the ferrous state, and is not precipitated in the absence of air, owing to the excess of ammonium chloride present.

The solubility of iron in solutions of different concentration does not diminish proportionally with the amount of ammonium chloride present; hence it is probably due to the action of hydrogen ions formed by hydrolysis of the salt, as similar proportional numbers are found for the solubility of iron and for the catalytic effect of the solutions on the hydrolysis of methyl acetate. The rate of rusting of iron in these solutions varies with the concentration in a similar manner, leading to the conclusion that rusting is due to the (mainly catalytic) action of hydrogen ions. In support of this, it is found that the chlorides of weak bases accelerate rusting far more than do those of the strong bases, and that the influence of acids is roughly proportional to their avidities.

Discussion.

Dr. Moody thought it unfortunate that chemists were not definitely agreed as to the exact meaning to be attached to the term rusting. It appeared desirable that the term should be limited to those changes which metals undergo on exposure to air under normal atmospheric conditions. With regard to the results obtained by the author of the paper under discussion, it must be borne in mind that on heating a solution of ammonium chloride at 80° ammonia would be evolved, and free hydrochloric acid would be formed in solution. In fact, the experiments resolved themselves into a determination of the attack on iron by solutions of hydrochloric acid of different strengths, and the theoretical conclusions drawn by the author appeared unwarranted.

Dr. F. M. Perkin agreed with Dr. Moody that the term rusting should be used to denote the atmospheric oxidation of iron, and should not be employed in reference to oxidation by other agencies.

He pointed out that many other metals were dissolved by ammonium salts, and asked whether Mr. Nance had tried the action of ammonium persulphate, which dissolved iron much more rapidly than other ammonium salts. The solution of the metals was evidently due to hydrolysis, and, as ferric salts are much more readily hydrolysed than ferrous salts, the explanation of the rapid solution in ammonium persulphate was to be traced to the conversion of the ferrous salt into the ferric condition. Oxidation of iron might be brought about by any feebly ionised acid. With highly ionised acids, as long as excess of acid is present, no precipitation of hydroxide will take place, but with excess of iron, hydrolysis will ultimately ensue.

In reply, Mr. Nance said that he considered his results sufficient to prove that atmospheric corrosion and rusting of iron takes place through the catalytic intervention of hydrogen ions.

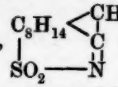
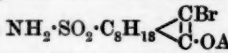
***100. "Aromatic compounds obtained from the hydroaromatic series. Part II. The action of phosphorus pentachloride on trimethyldihydroresorcin." By Arthur William Crossley and James Stuart Hills.**

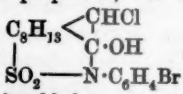
When phosphorus pentachloride acts on trimethyldihydroresorcin, two substances are produced, a liquid boiling at 118—119° at 33 mm., which is 3 : 5-*dichloro*-1 : 1 : 2-*trimethyl*-$\Delta^{2:4}$-*dihydrobenzene*, and a solid melting at 76·5°, namely, 3 : 5-*dichloro*-1 : 2 : 6-*trimethylbenzene*. This aromatic dichloride is converted on oxidation into 3 : 5-*dichlorohemimellitic acid*, crystallising from water in transparent, hexagonal plates, containing $2H_2O$ and melting at 226—227°, at which tem-

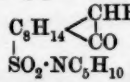
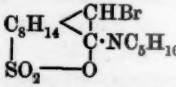
perature it is rapidly converted into its *anhydride*. The *trimethyl ester* crystallises in rhombohedra melting at 62—63°, and the *monomethyl ester* melts at 141—142°.

***101. "Studies of dynamic isomerism. Part V. Isomeric sulphonic derivatives of camphor." By Thomas Martin Lowry and Egbert H. Magson.**

Measurements were given of the solubility of a series of twenty sulphonic derivatives of camphor, both alone and in presence of a trace of alkali. The majority of the compounds derived from α-bromocamphor and α-chlorocamphor showed an increase of solubility similar to that observed in these compounds themselves and in their β- and π-halogen derivatives (Lowry, Proc., 1906, **22**, 70).

In the case of camphor sulphonamide, a decrease of solubility resulted from the addition of alkali, and it was found that the amide, which crystallises unchanged from acetic anhydride, had been converted quantitatively by *N*/500 sodium ethoxide in alcoholic solution at 20° into the anhydramide,  . The π-amide derived from α-bromocamphor could not be converted into an anhydramide, but was found to yield an acetyl derivative, the solubility of which was unchanged by the addition of alkali; the compound is therefore formulated as  .

The β-sulphonanilides derived from α-bromocamphor and α-chlorocamphor dissolve readily in caustic soda and are reprecipitated by acids. Possibly on account of their acid properties, the anilides, which may be formulated as, for example,  , do not increase in solubility when a trace of alkali is added.

The isomerism previously observed in the camphor sulphopiperidides (Armstrong and Lowry, *Trans.*, 1902, **81**, 1449) has now been detected in the α-bromopiperidides; both compounds, formulated as  and  , increase in solubility when alkali is added, and probably exist in stereoisomeric forms.

***102. "The densities of liquid nitrogen and liquid oxygen and of their mixtures." By John Kenneth Harold Inglis and Joseph Edward Coates.**

The authors have determined the densities of liquid nitrogen and of liquid oxygen, and of a number of mixtures of the two liquids at the temperatures 74·70° and 79·07° Abs. on the hydrogen scale. These are the temperatures at which the vapour pressure of pure oxygen is 100 mm. and 200 mm. respectively, and they are therefore easily reproduced. The results showed that a slight contraction took place on mixing the two liquids, this contraction being greater at the higher temperature. The densities of the pure liquids differed by about 1 per cent. from the values obtained by Baly and Donnan (*Trans.*, 1902, **81**, 907). These values of the densities of the mixtures may be used to determine the relation between the partial pressures of nitrogen and oxygen above a mixture of the two liquids and their concentrations in that mixture. It is found that the solubility of nitrogen in oxygen obeys Henry's law; but that the solubility of oxygen in nitrogen does not obey the simple form of that law, for oxygen dissolved in nitrogen is associated to the extent of about 9 per cent.

103. "Glutaconic and aconitic acids." By Harold Rogerson and Jocelyn Field Thorpe.

Ruhemann is mistaken when he states (Proc., 1906, **22**, 137) that we were not fully acquainted with his several publications dealing with these acids.

When we recorded the reactions of γ- and *βγ-alphyl* substituted derivatives of 2 : 6-dioxypyridine (*Trans.*, 1905, **87**, 1682), we compared them with the corresponding reactions of the *alphyl* β-substituted derivatives prepared by Ruhemann (*Trans.*, 1893, **63**, 876). The γ- and βγ-derivatives prepared by him (*Trans.*, 1899, **75**, 245), and which he complains have not been mentioned by us, are *aryl* derivatives containing phenyl and benzyl groups in these positions, and therefore were not, in our opinion, suitable for the purpose of comparison. As a matter of fact, the behaviour of our alphyl compounds differs in many important respects from that of the aryl compounds prepared by him.

Ruhemann has also evidently misunderstood our meaning, since he writes (*loc. cit.*): "They state that ethyl dihydroxycinchomeronate had *first* been prepared by Errera and Perciabosco, but they overlook the fact that Ruhemann and Stapleton had obtained it the year before." The passage referred to (*Trans.*, 1906, **89**, 640) is: "It is evidently

identical with the compound prepared by Errera and Perciabosco by the action of hydrochloric acid on ethyl 2 : 6-dihydroxypyridine-3 : 4 : 5-tricarboxylate." We did not desire to assign priority to Errera and Perciabosco, but merely wished to establish the identity of our compound, an object which seemed to us better attained by referring to the method of preparation adopted by these chemists, rather than to the more indirect process used by Ruhemann and Stapleton.

We have carefully re-read the paper by Ruhemann and Orton (*Ber.*, 1894, **27**, 3449), and are still of the opinion that the remark (*Trans.*, 1906, **89**, 634), "Ruhemann and Orton suggest that aconitic acid corresponds to fumaric acid in constitution, whereas the malenoid form is represented by aceconitic acid," is not an overstatement of the case, since probability surely implies suggestion.

Regarding the criticism of our formulæ for these acids and the remark that, if they were correct, then the action of ammonia on ethyl aconitate might be expected to yield a five-membered ring compound besides citrazinamide, we cannot too strongly emphasise the remarks we made in our reply to Feist and Beyer (*Trans.*, 1906, **89**, 650), which were to the effect that our formulæ for these compounds are merely an effort to represent diagrammatically a state of equilibrium between two tautomeric forms.

104. "The chemistry of organic acid 'thiocyanates' and their derivatives." By Augustus Edward Dixon.

Compounds of the class R·CO(CNS), when reacting with primary nitrogenous bases, present marked differences of behaviour, according to the nature of the hydrocarbon radicle, R. If R be aromatic, these compounds behave in ordinary circumstances principally as thiocarbimides, uniting additively with the base employed to form in each case a symmetrically disubstituted thiocarbamide: $R{\cdot}CO{\cdot}NCS + R'NH_2 = RCO{\cdot}NH{\cdot}CS{\cdot}NHR'$. On the other hand, if R be a fatty radicle, the function of the associated group, –CO(CNS), varies greatly with the conditions—notably temperature and the nature of the base presented. In such cases, the end-products contain both disubstituted thiocarbamide and a mixture of substituted amide with thiocyanic acid, the latter substances originating through double decomposition: $R{\cdot}CO{\cdot}SCN + R'NH_2 = R{\cdot}CO{\cdot}NHR' + H{\cdot}SCN$.

The interposition of an oxygen atom between the radicle R and the group CO(CNS), where the former belongs to the aliphatic series, increases the thiocarbimidic power of the resultant molecule: thus, phenacetyl "thiocyanate," $Ph{\cdot}CH_2{\cdot}CO(CNS)$, and phenoxyacetyl "thiocyanate," $Ph{\cdot}O{\cdot}CH_2{\cdot}CO(CNS)$, readily yield the reaction for thio-

cyanic acid, whilst carbo-benzoxy-"thiocyanate," $Ph\cdot CH_2\cdot O\cdot CO(CNS)$, does so to a very trifling extent.

A number of substituted thioureas and thiocarbamides are described, resulting from the action of ammonia or other bases on various thiocarbimides, $RO\cdot CO\cdot NCS$, where R = phenyl, *o*-tolyl, *p*-tolyl, and benzyl respectively.

When acetylphenylbenzylthiourea was heated under diminished pressure, a liquid distilled over having the general properties of acetyl "thiocyanate"; this fact is regarded as confirmatory of Hawthorne's view (*Trans.*, 1906, **89**, 566) that acetylthiocyanate is identical with acetylthiocarbimide.

Phenylchlorocarbonate united directly with thiourea to form a *compound* of formula $NH{:}C(NH_2)\cdot S\cdot CO\cdot OPh,HCl$; on treating with dilute alkali, diphenyl carbonate and thiourea were obtained and not the corresponding base. Unlike the fatty derivatives obtained from methyl or ethyl chlorocarbonate, the hydrochloride, when decomposed by heating, did not yield a *pseudo*-thiourea, $NH{:}C(NH_2)\cdot S\cdot Ph$.

105. "The molybdilactate and the tungstilactate of ammonium." By George Gerald Henderson.

The observations recorded in a previous paper (*Trans.*, 1903, **83**, 259) on the influence of molybdic and tungstic anhydrides on the specific rotations of solutions of alkali *l*-lactates pointed to the conclusion that compounds of the type $RO_2(C_3H_4O_3M)_2$ are formed both when the respective anhydrides are dissolved in hot solutions of the alkali lactates and when alkali molybdates and tungstates are heated with solutions of lactic acid. Attempts have since been made to isolate the molybdi- and tungsti-lactates so produced, only one of which, namely, potassium molybdilactate, had already been obtained in crystalline form, and then in very small quantity and in a slightly impure state (*Trans.*, 1899, **75**, 554). The results were disappointing so far as the metallic salts were concerned, but, on the other hand, well-defined, stable ammonium salts of molybdilactic and tungstilactic acids were easily obtained. Thus, finally, crystalline derivatives of the tartar emetic type have been prepared from all the hydroxy-acids which were selected for examination, and in the latter case, as in the others, the author's suggestions regarding the constitution of these compounds are supported by the results of experiment.

Molybdic and tungstic anhydrides are dissolved, the latter with some difficulty, when heated on the water-bath with solutions of alkali lactates. The reaction comes to an end when the substances are present in the proportion of one mol. anhydride to two mols. lactate, and no reduction of the anhydride occurs unless a trace in excess of that

amount is added, provided that the solution is not heated to boiling. Addition of alcohol to the concentrated solutions causes the separation of colourless, viscous liquids which do not become crystalline even on prolonged contact with the mother liquor. When left in a vacuum desiccator over sulphuric acid, the syrupy liquids slowly dry to amorphous, glassy masses, which are extremely deliquescent, very readily soluble in water, and fairly so in dilute alcohol. Owing to the failure of all attempts to induce these substances to crystallise, they could not be obtained in a satisfactorily purified state, but an analysis of the compound of molybdic anhydride and sodium lactate, partially purified by dissolving in a little water and precipitating with alcohol, showed that its percentage of sodium was only a little higher, and of molybdenum a little lower, than that required by the formula $MoO_2(C_3H_4O_3Na)_2$. Similar results were obtained by experiments with calcium and barium lactates. The anhydrides are dissolved fairly readily by hot solutions of these salts, but the compounds formed could not be isolated except as vitreous solids, which analysis proved to be somewhat impure.

The results were different when ammonium lactate was used. Molybdic anhydride was readily dissolved when heated on the water-bath with a solution of the salt, and, as in the case of the metallic lactates, no reduction took place unless a greater proportion of the anhydride than one mol. to two mols. lactate was added. After heating for some time, the solution was concentrated to a small bulk, and, after cooling, a quantity of a crystalline salt separated. The salt was purified by crystallisation from water, dried in a desiccator over sulphuric acid, and analysed :

1·0 gave 0·097 NH_3. $NH_3 = 9·7$.
0·5 „ 0·235 MoS_2. $Mo = 28·2$.
$MoO_2(C_3H_4O_3NH_4)_2$ requires $NH_3 = 10·0$; $Mo = 28·2$ per cent.

Ammonium molybdilactate, $MoO_2(C_3H_4O_3NH_4)_2$, forms small, colourless crystals which are fairly readily soluble in water and insoluble in alcohol. It is stable in the dry state at the ordinary temperature, but undergoes decomposition with loss of ammonia when heated in a steam oven. It is also stable in aqueous solution, but is hydrolysed on warming with dilute alkalis or mineral acids. When silver nitrate is added to a solution of the salt, a yellow precipitate is formed which quickly turns black if exposed to light.

Ammonium tungstilactate, $WO_2(C_3H_4O_3NH_4)_2$, was prepared and purified in a similar manner. It is a colourless, crystalline salt, closely resembling and apparently isomorphous with the corresponding molybdilactate, than which it is somewhat more stable, as it does not begin to decompose when heated until a temperature of about 120° is

reached, when ammonia is evolved. It dissolves in water fairly readily and without change. Analysis of the purified salt, dried at 100°, gave the following results:

0·5 gave 0·406 NH_3. $NH_3 = 8·12$.
0·5 „ 0·268 WO_3. $W = 42·5$.
$WO_2(C_2H_4O_3NH_4)_2$ requires $NH_3 = 7·94$; $W = 42·9$ per cent.

My thanks are due to Mr. Hugh B. Brown for assistance in this work.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Berkenhout, *John.* First lines of the theory and practice of philosophical chemistry. pp. xxiii + 434. London 1788. (*Recd.* 2/5/06.)
From Mr. A. W. Laurie.

British Institute of Preventive Medicine. Transactions. First series. London 1897. (*Reference.*) From the Lister Institute.

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II. *By Purchase.*

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Granger, *Albert.* La céramique industrielle. pp. x + 644. Paris 1905. (*Recd.* 16/5/06.)

Groth, *Paul Heinrich.* An introduction to chemical crystallography. Authorised translation by *Hugh* **Marshall.** pp. xii + 123. London 1906. (*Recd.* 16/5/06.)

Ingalls, *Walter Renton.* The metallurgy of zinc and cadmium. pp. xviii + 701. ill. New York 1903. (*Recd.* 24/3/06.)

Kŏnig, *J.* Die Untersuchung landwirtschaftlich und gewerblich wichtiger Stoffe. 3rd Edition. pp. xxiv + 1083. ill. Berlin 1906. (*Recd.* 16/5/06.)

Mann, *Gustav.* Chemistry of the proteids. Based on *Otto* **Cohnheim's** "Chemie der Eiweisskörper." pp. xviii + 606. London 1906. (*Recd.* 21/3/06.)

Meyer, *Victor,* and **Jacobson,** *Paul.* Lehrbuch der organischen Chemie. II Auflage. I Band, I Teil, 1 Abteilung. pp. 448. Leipzig 1906. (*Recd.* 21/3/06.)

Minet, *Adolphe.* The production of aluminium and its industrial use. Translated, with additions, by *Leonard* **Waldo.** pp. vi + 266. ill. New York 1905. (*Recd.* 24/3/06.)

III. *Pamphlets.*

Bayliss, *W. M.* The kinetics of tryptic action. (Reprinted from the *Archives des sciences biologiques,* **11,** 1904.)

Bihar Planters' Association. Report of the Indigo Research Station, Sirsiah (*under subsidy from the Government of Bengal*) for the year 1905—1906. By *Cyril* **Bergtheil.** pp. 29. Calcutta 1906.

Day, *Arthur L.,* and **Shepherd,** *E. S.* Quartz glass. (From *Science,* **23,** 1906.)

Kahlenberg, *Louis.* On the nature of the process of osmosis and osmotic pressure with observations concerning dialysis. (From the *Trans. Wisconsin Acad. of Sciences,* **15,** 1906.)

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RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in June next. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before Monday, June 4th, 1906.

Those Fellows who received grants in June 1905, or whose grants, allotted in June of previous years, have not been closed, are reminded that reports must be in the hands of the Hon. Secretaries not later than Friday, June 1st, 1906.

CLEVE MEMORIAL LECTURE.

The Cleve Memorial Lecture will be delivered by Professor T. E. Thorpe, C.B., F.R.S., on Thursday, June 21st, 1906, at 8.30 p.m., before the business of the Ordinary Meeting.

EXTRA MEETINGS.

An extra meeting will be held on Thursday, July 5th, at 8.30 p.m., and the new Session will begin on Thursday, October 18th.

At the next Ordinary Meeting, on Thursday, June 7th, 1906, at 8.30 p.m., the following papers will be read:

"Ammonium selenate and the question of isodimorphism in the alkali series." By A. E. H. Tutton.

"An improved Beckmann apparatus for molecular weight determination." By J. M. Sanders.

"Resolution of lactic acid by morphine." By J. C. Irvine.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 16/6/06

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 311.

Thursday, June 7th, 1906, at 8.30 p.m. Professor R. MELDOLA, F.R.S., President, in the Chair.

Messrs. E. Feilmann and H. G. Smith were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.:

Robert Anderson, Chester Road West, Sunderland.
Reginald William Malyon Gibbs, B.Sc., Hetty Villa, Cam Road, Chesterton, Cambridge.
Frederick James Martin, Passagem de Marianna, Minas, Brazil.
Herbert Arthur Mills, Waverley, Bloomfield Gardens, Bath.
Leonard Edward Beard Pearse, 79, Gordon Road, Ealing, W.
Thomas Ebenezer Pye, West View, Summersdale, Chichester.
Frederick John Salmon, c/o Princess Estate and Gold Mining Co., Ltd., P.O. Box 112, Roodepoort, South Africa.

Of the following papers, those marked * were read:

***106. "Ammonium selenate and the question of isodimorphism in the alkali series." By Alfred Edwin Howard Tutton.**

Normal ammonium selenate crystallises differently from the seven rhombic normal sulphates and selenates of the alkalis already

investigated, namely, in monoclinic prisms or tables, which are described in detail in the paper. A rhombic form of the salt was once obtained (in 1862) by von Lang, but neither Topsöe nor the author has been able to reproduce it in pure ammonium selenate. The author has obtained rhombic mixed crystals of ammonium selenate and sulphate, however, and concludes that ammonium selenate is dimorphous, and that the whole series of sulphates and selenates is probably isodimorphous, as has been shown to be the case with other series of the salts of ammonium, potassium, rubidium, and cæsium.

The original crystals investigated by Prof. von Lang have been kindly sent by him to the author, who finds that the majority are truly rhombic, but that they are somewhat impure, containing admixed sulphate, which is probably the reason for their production, for they closely resemble the author's mixed crystals, although much richer in selenate. Besides the rhombic crystals, however, some needles were found of nearly pure ammonium selenate, which are identical with the author's monoclinic form.

The monoclinic crystals of ammonium selenate show a pseudo-hexagonal primary prism zone very similar to that of the rhombic crystals of the other salts, and the topic parameters calculated on this analogous mode of description show a mean value for the structural dimensions intermediate between the mean values for rubidium and cæsium selenates. The molecular volume, refractive indices, dimensions of the optical ellipsoid, and the molecular optical constants are singularly near what would have been expected if the crystals had been truly isomorphically rhombic, and unite in exhibiting ammonium selenate in its proper position in the series immediately after rubidium selenate, precisely analogous to the position of ammonium sulphate in the sulphate series, and which the author has shown is the general position of ammonium crystallographically in the alkali series.

As a side issue, a general explanation has been arrived at for the beautiful optical property of crossed-axial-plane dispersion of the optic axes, ammonium selenate forming the fifth case of this somewhat rare phenomenon which has been met with in the alkali series.

***107. "The vapour pressures of binary mixtures. Part I. The possible types of vapour pressure curves." By Arthur Marshall.**

The curves showing the variations of partial pressures with molecular composition may be classified into four types, of which

three relate to substances which are miscible in all proportions, and are distinguished one from the other according as p/x, the partial pressure divided by the molecular proportion, is less than, equal to, or greater than the vapour pressure of the pure substance. The corresponding total pressure curves are obtained by adding together the two partial pressure curves, which are of the same type. By differentiating the equation of Duhem and Margules, $x d\log p_1 + (1-x) d\log p_2 = o$, it has been found possible to classify the total pressure curves into twelve types, all of which are known to occur.

It may be proved that with pairs of substances which are miscible in all proportions only one maximum or minimum can occur in the curve of total pressure. The rule, called by Duhem "Regnault's Law," that in the case of partially miscible liquids the total pressure of the heterogeneous mixture is equal to the vapour pressure of the more volatile constituent in the pure state, has been shown experimentally to be approximately true for methyl acetate and water as well as for ether and water, but it is only a rough approximation and is applicable only to some cases.

The vapour pressures of the following pairs of liquids have been investigated experimentally: nitroglycerol and acetone, diethylamine and acetone, ethyl alcohol and methyl ethyl ketone, water and methyl ethyl ketone, water and methyl acetate, water and ether, water and amyl alcohol. From the curve of total vapour pressures, the partial pressures may be obtained by a simple graphical method.

***108. "The behaviour of acetylene with electrical discharges of high frequency." By Herbert Jackson and Dudley Northall Laurie.**

The authors have studied the change, observed by one of them some years ago, when acetylene is subjected to discharges from an ordinary high-frequency apparatus. A semi-solid, brown substance is formed, which sets to a hard and very insoluble solid on exposure to air. If care be taken to avoid secondary reactions by too prolonged a passage of the discharge, the composition of the solid agrees with that of acetylene, and is apparently a polymeride. The substance absorbs oxygen readily up to about 8 per cent. When heated out of contact with air, an oil distils and a small quantity of gas is evolved, which consists mainly of methane and hydrogen. The authors are proceeding with the examination of the reactions of the substance, which exhibits many curious properties.

***109. "The behaviour of the vapours of methyl alcohol and acetaldehyde with electrical discharges of high frequency." By Herbert Jackson and Dudley Northall Laurie.**

The authors have examined the reactions as part of a series of experiments conducted with a view to determining the nature and order of change effected by high-frequency discharges when passed through various gases and vapours. Working with discharges of very short duration, they find the first change in the vapour of methyl alcohol to be the formation of carbon monoxide and hydrogen; in the case of acetaldehyde, the greater part of the vapour breaks up into methane and carbon monoxide, but acetylene and water are also produced simultaneously, though in smaller quantities. Both these changes are reversible, the latter more readily than the former. The authors have continued experiments conducted by one of them some time ago on a number of saturated and unsaturated compounds, and they have come to the conclusion that in the case of paraffin derivatives the general tendency is for unsaturated bodies to give polymeric varieties under the influence of high-frequency discharges, whilst saturated compounds, under similar conditions, yield substances of simpler structure.

Discussion.

In reply to the President: Prof. Jackson said that after trying acetylene made from varying sources, purified acetylene made from calcium carbide and a saturated solution of sodium carbonate was used. The gas was dried over phosphorus pentoxide. No process which could be considered as likely to depolymerise the product gave any acetylene.

In reply to Dr. M. O. Forster: Prof. Jackson called attention to the marked activity of the oxidised product obtained after exposing the tacky substance freely to air, and stated that the usual methods for examining for activity in the combined oxygen gave no positive results.

110. "Note on 4-bromo-2-nitro-1(α)-naphthylamine." By Raphael Meldola and Hugh Gordon Dale.

It was shown some years ago by one of the authors and C. H. Desch (*Trans.*, 1892, **61**, 765) that the above compound could be diazotised under the usual conditions with the formation of diazonium salts which were stable in the presence of excess of sulphuric acid and in cooled solutions. In repeating the diazotisation of the base for another purpose, the authors have found that if the solution of the diazonium sulphate is diluted with water and warmed, an immediate

decomposition takes place with the elimination of the nitro-group and the formation of a diazo-oxide :

$$Br\cdot C_{10}H_5\langle{}^{N_2\cdot HSO_4}_{NO_2} \longrightarrow Br\cdot C_{10}H_5\langle{}^{N_2(\alpha)}_{O\ (\beta)}\Big(\text{or } Br\cdot C_{10}H_5\leqslant{}^{N_2}_{O}\Big).$$

This compound is therefore isomeric with the diazo-oxide described by one of the authors and F. W. Streatfeild in 1895 (*Trans.*, 67 907), and is identical with the compound more recently described by K. J. P. Orton (*Proc.*, 1902, **17**, 253), with which it agrees in melting point (132°) and other properties.

0·0759 gave 7·3 c.c. moist nitrogen at 11° and 765 mm. N = 11·46.

$C_{10}H_5ON_2Br$ requires N = 11·25 per cent.

The chief point of interest attaching to the present mode of formation of the compound is that it is produced by the elimination of the β-nitro-group, instead of by the displacement of the β-halogen atom, as in Orton's process.

The diazo-oxide on boiling with cuprous chloride solution is converted into 1-chloro-4-bromo-2(β)-naphthol, which crystallises from dilute alcohol in white needles melting at 112° and becoming yellowish-brown on exposure to the air.

0·0851 gave 0·1022 AgCl + AgBr.

$C_{10}H_6OClBr$ requires 0·1026 AgCl + AgBr.

Special interest attaches to this chlorobromonaphthol in connection with the replaceability of the second $\beta(=3)$-hydrogen atom, from which point of view the compound may be worth detailed study. Attempts to prepare the 1-chloro-4-bromo-2 : 3-naphthaquinone have so far led to negative results, but the experiments will be repeated under different conditions.

111. "Dinitroanisidines and their products of diazotisation (second communication)." By Raphael Meldola and Frank George C. Stephens.

By the nitration of diacetyl-*m*-aminophenol, the authors have obtained a mixture of two isomeric mononitroacetaminophenols, which, on hydrolysis, yield respectively 4-nitro-3-aminophenol (m. p. 185—186°) and 6-nitro-3-aminophenol (m. p. 158°). The nitroacetaminophenols on nitration both yield the same dinitro-derivative, 4 : 6-dinitro-3-acetaminophenol (m. p. 168°), and this hydrolyses to 4 : 6-dinitro-3-aminophenol. The latter crystallises in dull orange needles of m. p. 231°. The methyl ether (= 4 : 6-dinitro-*m*-anisidine)

obtained by direct methylation, or, more advantageously, by the direct nitration of *m*-acetaminophenol methyl ether, crystallises in small, canary-yellow needles of m. p. 208° (acetyl derivative, m. p. 146°). This dinitro-*m*-anisidine does not lose a nitro- or methyl-group on diazotisation, but forms diazonium salts of the ordinary type. From this, combined with former results, the authors conclude that the conditions essential for the elimination of a nitro-group on diazotisation are that there should be a nitro-group, ortho- or para- with respect to the diazonium group, and that this displaceable nitro-group should have a similar group (or possibly a halogen atom) in the ortho-position with respect to itself. Experiments with other dinitro- and haloid-nitroanisidines are in progress.

112. "The action of sulphur dioxide and aluminium chloride on aromatic compounds." By Samuel Smiles and Robert Le Rossignol.

The authors have previously shown (*Trans.*, 1906, **89**, 696) that thionyl chloride reacts with phenetole in the presence of aluminium chloride, giving rise successively to a sulphoxide and a sulphonium base; it has since been found that this reaction may be brought about by sulphur dioxide with the aid of the same condensing agent. An examination of the behaviour of various phenolic ethers towards these reagents has shown that the products of the reaction vary according to the nature and position of the substituents in the aromatic nucleus, and in some cases it has been possible to isolate the primary product, the sulphinic acid, in considerable quantity. Preliminary experiments have indicated that the aromatic hydrocarbons are attacked in a similar manner.

113. "Action of sodium on *aa*-dichloropropylene." By Ida Smedley.

Van Romburgh and van Dorssen have shown (*Proc. K. Acad. Wetensch. Amsterdam*, 1905, **8**, 565) that the simplest hexatriene, $CH_2{:}CH{\cdot}CH{:}CH{\cdot}CH{:}CH_2$, may be synthesised by heating the diformate of *s*-divinyl glycol.

During the past year, the author has endeavoured to prepare a series of hexatrienes from *aa*-dichloropropylene and its homologues. A preliminary account of these experiments is now put forward.

Hübner and Genther state that *aa*-dichloropropylene is indifferent to sodium (*Annalen*, 1860, **114**, 36). The author finds that if a solution of this substance in petroleum (b. p. 100—110°) is heated

with potassium or sodium on a water-bath at about 80° during several days and the petroleum solution separated and fractionally distilled, a small amount of a liquid boiling at 60° and a still smaller quantity of a fraction boiling at about 80° can be isolated. A relatively large proportion of a brown, amorphous solid, insoluble in petroleum or water, is also formed in this reaction.

The fraction boiling at 60° gave the following results on analysis :

C = 87·0 ; H = 11·85.

C_6H_{10} requires C = 87·81 ; H = 12·19 per cent.

Vapour density found 44, calculated 41.

It united readily with bromine, forming a white, solid tetrabromide melting at 51° and containing 80·02 per cent. of bromine. The liquid was therefore diallyl.

The amount of the fraction boiling from 80° to 83° was insufficient for identification ; it was probably the hexatriene now isolated by van Romburgh and van Dorssen.

The method is being applied for the reduction of αα-dichloro-γ-phenylpropylene and of αα-dichloro-γ-methylpropylene ; the substances obtained in these experiments are at present under examination.

114. "Resolution of lactic acid by morphine." By James Colquhoun Irvine.

Fermentation lactic acid may be readily resolved into its active components by the crystallisation of the morphine salts. On neutralising an aqueous solution of the inactive acid with the alkaloid, the sparingly soluble morphine *l*-lactate separated almost quantitatively, whilst the compound with the *d*-acid remained in solution. The crystalline morphine salt was converted into zinc *l*-lactate, which gave $[\alpha]_D^{20°}$ +6·84° and a more accurate test of the purity of the active acid was obtained by its conversion by means of the silver oxide reaction into methylic *l*-methoxypropionate, which showed $[\alpha]_D^{20°}$ +94·7°.

The latter compound was reduced by hydriodic acid to *l*-lactic acid, a reaction which shows that silver oxide does not affect the configuration of an active lactate.

By decomposing the syrup containing the soluble morphine *d*-lactate, more than 50 per cent. of the theoretical yield of the active zinc salt ($[\alpha]_D^{20°}$ −6·83°) was obtained.

115. "Brazilin and hæmatoxylin. Part VIII." By William Henry Perkin, jun., and Robert Robinson.

The following synthetical experiments have been commenced with the object of obtaining additional evidence as to the constitution of brazilin and hæmatoxylin.

α-Hydrindone, $C_6H_4{<}^{CO}_{CH_2{\cdot}CH_2}$, condenses readily with salicylaldehyde in the presence of caustic potash, and is converted into *salical-α-hydrindone*, $C_6H_4{<}^{CO}_{CH_2{\cdot}C{:}CH{\cdot}C_6H_4{\cdot}OH}$, which crystallises in yellow needles and decomposes at 206°. It yields a brilliant red potassium derivative, but does not appear to combine with hydrogen chloride.

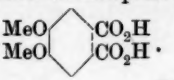
When methylenedihydrocaffeic acid, $CH_2{:}O_2{:}C_6H_3{\cdot}CH_2{\cdot}CH_2{\cdot}CO_2H$, is treated with phosphorus pentachloride and then with aluminium chloride (compare Kipping, *Trans.*, 1894, **65**, 484), it is converted into *methylenedihydroxy-α-hydrindone*, $CH_2{:}O_2{:}C_6H_2{<}^{CO}_{CH_2{\cdot}CH_2}$, which melts at 160°. The *oxime*, $CH_2{:}O_2{:}C_6H_2{<}^{C{:}N{\cdot}OH}_{CH_2{\cdot}CH_2}$, obtained by the action of hydroxylamine hydrochloride and caustic potash in the usual manner, melts at 246° with decomposition. iso*Nitrosomethylenedihydroxy-α-hydrindone*, $CH_2{:}O_2{:}C_6H_2{<}^{CO}_{CH_2{\cdot}C{:}N{\cdot}OH}$, is formed when an alcoholic solution of methylenedihydroxy-α-hydrindone is mixed with *iso*amyl nitrite and hydrochloric acid. It crystallises in yellow needles, decomposes at 230°, and when treated first with phosphorus pentachloride and then with caustic potash, yields *methylenedihydroxyhomophthalic acid*, $CH_2{:}O_2{:}C_6H_2(CO_2H)CH_2{\cdot}CO_2H$, which crystallises from water and melts at about 236°.

Benzalmethylenedihydroxy-α-hydrindone, $CH_2{:}O_2{:}C_6H_2{<}^{CO}_{CH_2{\cdot}C{:}CH{\cdot}C_6H_5}$, is produced when methylenedihydroxy-α-hydrindone is treated with benzaldehyde and alcoholic potash, and crystallises in pale yellow needles which decompose at about 250°.

4 : 5-*Dimethoxy-α-hydrindone* (1 : 2), $(MeO)_2C_6H_2{<}^{CO}_{CH_2{\cdot}CH_2}$, is obtained when dimethyldihydrocaffeic acid,

$$(MeO)_2{\cdot}C_6H_3{\cdot}CH_2{\cdot}CH_2{\cdot}CO_2H,$$

is treated with phosphorus pentachloride and then with aluminium chloride. It crystallises from benzene, melts at 114°, and, when oxidised with nitric acid, yields *m*-hemipinic acid,



The *iso*nitroso-derivative, $(MeO)_2C_6H_2 \cdot CH_2 \cdot C(CO) \cdot C{:}N \cdot OH$, crystallises in yellow needles which decompose at about 240°.

Salicaldimethoxy-α-hydrindone, $(MeO)_2C_6H_2 \cdot CH_2 \cdot C(CO) \cdot CH \cdot C_6H_4 \cdot OH$, is produced when dimethoxy-α-hydrindone is treated, in alcoholic solution, with salicylaldehyde and caustic potash. It crystallises in yellow needles, yields a brick-red hydrochloride, and a brilliant red, crystalline potassium derivative.

p-*Methoxysalicaldimethoxy-α-hydrindone*,

$$(MeO)_2C_6H_2 \cdot CH_2 \cdot C(CO) \cdot CH \cdot C_6H_3(OMe) \cdot OH,$$

is of special interest on account of the close relationship which it bears to trimethylbrazilin. It is obtained when dimethoxy-α-hydrindone is treated with *p*-methoxysalicylaldehyde and caustic potash in alcoholic solution, and crystallises from *iso*amylic alcohol in prisms which decompose at about 230°. It yields a golden-yellow potassium derivative and a crimson hydrochloride.

The authors are engaged in the further investigation of the above and other analogous substances.

116. "A study of the reaction between hydrogen peroxide and potassium persulphate." By John Albert Newton Friend.

It is shown that solutions of hydrogen peroxide and potassium persulphate interact according to the equation $H_2O_2 + K_2S_2O_8 = 2KHSO_4 + O_2$. The reaction, however, is monomolecular. This is due to the formation of an intermediate and highly unstable compound, directions for the preparation of which are given. Sulphuric acid is found to exert a retarding influence on the reaction, as do the sulphates of sodium, potassium, and manganese, the last-named accelerating slightly as the reaction nears completion. The action of colloidal platinum has also been studied.

117. "The action of magnesium methyl iodide on dextrolimonene nitrosochlorides." By William Augustus Tilden and Frederick George Shepheard.

The α- and β-nitrosochlorides were treated separately, but yielded similar products differing only in melting point and degree of optical activity. The compound formed in each case differs in composition from the nitrosochloride by one atom of oxygen, and therefore has the formula $C_{20}H_{32}ON_2Cl_2$. It is insoluble in aqueous alkalis and in acids, though easily soluble in the usual organic solvents. Alcoholic potash removes the elements of hydrogen chloride, but the resulting oil rapidly changes in contact with the air. No definite derivatives could be obtained by the use of any reagent except phosphorus pentachloride, which replaces the remaining atom of oxygen by two atoms of chlorine. The product, $C_{20}H_{32}N_2Cl_4$, is optically active and readily loses two molecules of hydrogen chloride, yielding the compound $C_{20}H_{30}N_2Cl_2$, which is also optically active and saturated. The product of the action of phosphorus pentachloride does not react as a nitrogen chloride.

118. "Electrolysis of potassium ethyl dipropyl malonate." By David Cowan Crichton.

A concentrated aqueous solution of potassium ethyldipropylmalonate yields on electrolysis the ethyl esters of *α-propyl-β-ethyldcrylic acid*, *dipropylglycollic acid*, *tetrapropylsuccinic acid*, and probably *dipropylacetic acid*.

The dipropylglycollic acid obtained in the electrolysis was proved to be identical with the "dipropyloxalic acid" of Rafalsky.

Tetrapropylsuccinic acid yields an anhydride which is characterised by the same stability towards alkalis as tetraethylsuccinic anhydride.

119. "A new method for the measurement of hydrolysis in aqueous solution, based upon the consideration of the motion of ions." By Robert Beckett Denison and Bertram Dillon Steele.

The authors have previously described a method for the direct determination of transport numbers and ionic velocities which necessitates the employment of an auxiliary or indicator solution. This indicator must not be hydrolysed if accurate results are to be obtained, since hydrolysis causes the production of new ions which have an effect on the apparent velocity of the ion which is being subjected to measurement. Thus, if lithium chloride is used as an indicator for potassium

chloride, correct numbers for the velocity of the $K^{\cdot}$ ion are obtained, since lithium chloride is not hydrolysed in solution. If, however, a salt of the nature of aniline hydrochloride is used as indicator, the $H^{\cdot}$ ions which are produced as the result of hydrolysis cause a false value to be obtained for the velocity of the $K^{\cdot}$ ion. The difference between the real and apparent velocities of the $K^{\cdot}$ ion is dependent on the degree of hydrolysis of the indicator, and it has been found possible, by means of a study of the motion of the different ions in the system, to deduce a formula which gives values for the degree of hydrolysis in the indicator solution well in accordance with the numbers commonly accepted as correct. The only measurements which have to be made are three conductivity determinations. Measurements have been carried out with three salts, namely, the hydrochlorides of aniline, *ortho*- and *para*-toluidine at 18° and 25°. The values obtained for the "hydrolysis constants" are :

	Aniline hydrochloride.	*o*-Toluidine hydrochloride.	*p*-Toluidine hydrochloride.
At 18°	$61{\cdot}9 \times 10^3$	$46{\cdot}0 \times 10^3$	256×10^3
„ 25°	$43{\cdot}6 \times 10^3$	$29{\cdot}6 \times 10^3$	186×10^3

This gives for the "dissociation constants" of the respective bases (assuming for water $H^{\cdot} \times OH' = 1{\cdot}2 \times 10^{-14}$) at 25° :

$$\text{Aniline} = 5{\cdot}2 \times 10^{-10}$$
$$o\text{-Toluidine} = 3{\cdot}5 \times 10^{-10}$$
$$p\text{-Toluidine} = 22 \times 10^{-10}$$

From the values obtained for the "hydrolysis constants" of the hydrochlorides at 18° and 25°, the heat of hydrolysis was calculated by the application of van't Hoff's equation. The results were in fair agreement with the values obtained calorimetrically, the numbers being as follows :

Aniline hydrochloride	.....	8700 cals.
o-Toluidine „	.....	11000 „
p-Toluidine „	.....	7900 „

120. "The oxidation of hydrocarbons by ozone at low temperatures." By Julien Drugman.

Experimental proof is given that the mode of action of ozone on a saturated and an unsaturated hydrocarbon is very different.

Ozone acts, at the ordinary temperature, very slowly on saturated hydrocarbons such as methane and ethane. The process is one of gradual hydroxylation. In the case of ethane, ethyl alcohol is shown to be the first product formed.

The reaction in the case of an unsaturated hydrocarbon such as ethylene is instantaneous, even at temperatures far below 0°.

A very explosive addition compound is first formed, which decomposes extremely readily, giving oxidation products containing only one carbon atom. The carbon chain is broken at the double bond.

Comparison with the results of Harries' work make it probable that the addition product is an ozonide, but the decomposition of this is more complex than that usually obtained with a liquid or solid ozonide. The following equations probably represent the process:

$$(1)\ C_2H_4 + O_3 = C_2H_4O_3 = \begin{cases} (a)\ CH_2O + HCO_2H \\ (b)\ CH_2O + CO + H_2O \end{cases}$$

$$(2)\ C_2H_4O_3 + H_2O = 2CH_2O + H_2O_2.$$

Formaldehyde, formic acid, carbon monoxide, hydrogen peroxide, and water are obtained.

121. "Reactions involving the addition of hydrogen cyanide to carbon compounds. Part V. Cyanodihydrocarvone." By Arthur Lapworth.

The nitrile formed when carvone unites with one molecular proportion of hydrogen cyanide (Hann and Lapworth, *Proc.*, 1904, **20**, 54) is cyanodihydrocarvone, $CHMe\langle^{CO\text{———}CH_2}_{CH(CN)\cdot CH_2}\rangle CH\cdot CMe{:}CH_2$, and the two acids to which it gives rise on hydrolysis are the corresponding stereoisomeric carboxylic acids. Evidence of the occurrence of reversible dynamic isomerism in the nitrile and the two acids has been obtained.

The properties of these compounds and of a number of their derivatives are described.

122. "Thiocarbamide as a solvent for gold." By James Moir.

Two new complex gold-salts have been obtained by dissolving gold in an acid solution of thiocarbamide (*Proc.*, 1906, **22**, 105). They approximate in composition to $Au_2SO_4 + 6CH_4N_2S$ and $AuCl + 2\frac{2}{3}CH_4N_2S$ respectively, but the author considers that the correct formulæ are $C_6H_{20}N_{12}S_6Au_2(SO_4)$ and $C_8H_{26}N_{16}S_8Au_3Cl_3$ respectively, and that both contain a complex cation $C_2H_6N_4S_2Au^+$ [most probably $NH{:}C(NH_2)\cdot S(Au)\cdot NH\cdot CS\cdot NH_2^+$]. The author suggests that the abnormal cuprous-thiocarbamide salts have similar constitutions.

The chloride has been studied in some detail. It is converted into the compound described by Reynolds, $C_2H_8N_4S_2AuCl$, by boiling with

hydrochloric acid. Its formation from aurichloride and thiocarbamide takes place according to the equation: $3AuCl_3 + 8CH_4N_2S = C_8H_{26}N_{16}S_8Au_3Cl_3 + 6HCl$.

On warming with sodium hydrate solution, it gives the olive-green gold compound described by B. Rathke (*Ber.*, 1884, 17, 307), which the present author formulates as $CH_8N_2S_2Au_3$; the filtrate contains chloride and sulphide of sodium. On heating to 210° until constant, the brown residue appears to have the composition $Au_3S_2 \cdot 3CH_4N_2S$.

Silver nitrate gives a mixture of silver chloride, auric hydrate, and silver thiocarbamide in the proportions required by the formula assigned to the original substance.

Substituted thiocarbamides have no action on gold.

123. "An improved Beckmann apparatus for molecular weight determinations." By James McConnell Sanders.

In the determination of molecular weights by the freezing-point method, employing the Beckmann apparatus as usually constructed, several sources of error have to be contended with, some of which depend on the form of the apparatus, and are considerably augmented when hygroscopic solvents such as acetic acid are used.

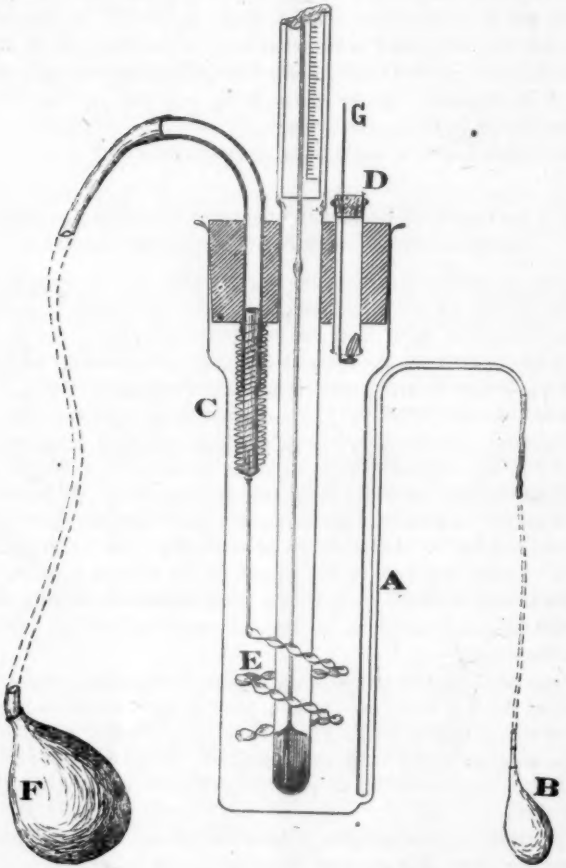
One of the chief difficulties is to equalise the overcooling for parallel observations with the solvent and solution, and it is not always easy to add the ice crystals which induce congelation at correspondingly equal temperature intervals from the freezing point. With the little contrivance ("Impfstift") recommended by Beckmann for this purpose, several errors are liable to be introduced; an unknown, or at least a variable, addition to the weight of the solvent is made, the ice crystals absorb moisture during their transference, and during the time that the side tube is open, moisture is absorbed by the solvent in the tube.

Moreover, when the temperature of the surrounding atmosphere is but a few degrees above the freezing point of the solvent, it is difficult to ensure the addition of the crystals to the solvent or solution at the precise moment when they are required. Another source of error exists in the introduction of moist atmospheric air by the action of the stirrer.

The author has succeeded in eliminating these errors by the use of the modified form of inner tube described in this paper.

The principal feature of the new inner tube consists in the use of the narrow, almost capillary side-tube, *A*, which is fused into the bottom of the solution tube, and is carried up and bent so as to permit the attachment of a thin rubber tube and small bulb, *B*. When the solvent has been placed in the containing tube, the height of the

column of liquid in *A* can easily be adjusted by first expelling it completely by compression of *B*, then pinching the rubber tube while *B* is removed, allowed to fill itself with air, and replaced. On releasing the rubber tube, a small amount of the solvent rises in *A*, and the height of the column subsequently increases owing to the contraction



of the air in the tube produced by the cooling. The container tube is placed in a wide jacket tube (not shown in the figure) in such a way that the side-tube, *A*, is in contact with the walls of the latter; a better arrangement is to employ a tube with a lateral canal such as is provided in some hydrometer cylinders.

In operation, the column of solvent in *A*, being nearer to the source of cold, freezes first, and at the moment desired a mass of crystals can be projected into the main body of the solvent by a sharp compression of the bulb, *B*.

The pneumatic stirrer, *C*, is almost self-explanatory; it is an adaptation of the well-known pneumatic "shutter release," found on the majority of photographic cameras. The piston and cylinder are of aluminium or glass ground to fit perfectly (in the author's laboratory use was made of a glass hypodermic syringe of small diameter), the agitator, *E*, is made by flattening a portion of the length of a piece of platinum wire, and then twisting the flattened portion in the manner shown; the twisted part is coiled into a spiral form, and the other end of the wire fixed to the end of the plunger or piston. The spring which balances the weight of the agitator is made of hard drawn aluminium or platino-iridium wire, sufficient length being given to it to allow of a somewhat extended "stroke."

One of the conveniences attending this arrangement lies in the fact that both stirrer and "crystallisation inducer" can be easily operated without the fatigue attendant on the use of the ordinary form; the operator's hands rest on the table, and he can conveniently observe the thermometer without his attention being distracted by manipulative details.

The ordinary side-tube of the Beckmann apparatus is replaced by the small vertical tube, *D*, which passes through a third perforation in the rubber stopper. The introduction of the substance can be accomplished by the momentary removal of the stopper of *D*, or if it should be desired to avoid all possibility of the entrance of atmospheric air, the substance in the form of a compressed tablet can be previously placed in *D* and sustained by a bent wire, *G*, a half revolution of the latter allowing the tablet to drop into the solvent at the desired moment.

The apparatus can easily be constructed by anyone accustomed to glass working, or it can be adapted from a small Soxhlet extraction tube by cutting off the upper and lower parts and the wide side tube and bending the narrow syphon tube into the form of *A*.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

American Electrochemical Society. Transactions. Vols. IV—VII. Philadelphia 1903—1905. (*Reference*). From Dr. F. Mollwo Perkin.

Hollard, *A.*, and **Bertiaux,** *L.* Analyse des métaux par électrolyse. pp. xi + 180 + iv. Paris 1906. (*Recd.* 28/5/06.)

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Blount, *Bertram.* Practical electro-chemistry. 2nd Edition. pp. xi + 394. ill. London 1906. (*Recd.* 18/5/06.)

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CLEVE MEMORIAL LECTURE.

The Cleve Memorial Lecture will be delivered by Professor T. E. Thorpe, C.B., F.R.S., on Thursday, June 21st, 1906, at 8.30 p.m., before the business of the Ordinary Meeting.

EXTRA MEETINGS.

An extra meeting will be held on **Thursday, July 5th,** at **8.30** p.m., and the new Session will begin on Thursday, October 18th.

At the next Ordinary Meeting, on **Thursday, June 21st, 1906,** at **8.30** p.m., the following papers will be communicated, after the delivery of the Cleve Memorial Lecture:

"The constituents of the essential oil from the fruit of *Pittosporum undulatum.*" By F. B. Power and F. Tutin.

"Mobility of substituents in derivatives of β-naphthol." By J. T. Hewitt and H. V. Mitchell.

R. CLAY AND SONS, LIMITED, BREAD STREET HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 29/6/06

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 312.

Thursday, June 21st, 1906, at 8.30 p.m. Professor R. MELDOLA, F.R.S., President, in the Chair.

Professor T. E. THORPE, F.R.S., delivered the Cleve Memorial Lecture. A vote of thanks to the lecturer was proposed by Sir Henry E. Roscoe, seconded by Professor Tilden, and carried by acclamation.

The PRESIDENT announced that the Council had awarded the Longstaff medal to Professor W. N. Hartley, F.R.S., in recognition of his spectrochemical investigations; the presentation will be made at the first meeting of the new session, Thursday, October 18th, at 8.30 p.m.

Messrs. H. G. F. Micklewright and J. S. Hills were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.:

Samuel Field, 53, Whitburn Road, Lewisham, S.E.

Frederick James Harris, 1, Alexandra Terrace, Bath Road, Exeter.

Archibald McArthur Johnston, Box 108, Germiston, Transvaal, South Africa.

Emmanuel Isaac Thorne, 13, Cantwell Road, Plumstead, S.E.

Frederick William Watson, B.Sc., P O. Box 108, Germiston, Transvaal, South Africa.

A certificate has been authorised by the Council for presentation for ballot under Bye-Law I (3) in favour of:

Dr. Charles H. Hertz, Chapel Hill, North Carolina, U.S.A.

Of the following papers, those marked * were read:

***124. "The constituents of the essential oil from the fruit of *Pittosporum undulatum*." By Frederick Belding Power and Frank Tutin.**

The oil employed in this investigation was freshly distilled for the purpose in Australia. From 220 kilograms of the nearly ripe fruit, gathered during December and January, 960 grams of oil were obtained, corresponding to a yield of 0·44 per cent. The essential oil is pale yellow, and has a pleasant odour resembling that of orange oil. Its constants were as follows: $d15°/15° = 0·8615$; $\alpha_D + 74°4'$ in a 1-dcm. tube. It was insoluble in ten times its volume of 70 per cent. alcohol.

The results of the investigation have shown that Pittosporum oil contains the following substances: *d*-pinene (nitrosochloride; nitrolbenzylamine, m. p. 123°), about 4 per cent.; *d*-limonene (tetrabromide, m. p. 104°), about 75 per cent.; esters of valeric, formic, and other acids, a small amount; an optically inactive *sesquiterpene* (b. p. 263—264°, corr.; $d15°/15° = 0·9100$; $n_D^{20°} = 1·5030$; molecular refraction, 66·22), about 15 per cent.; palmitic acid and an undetermined phenol in very small amount, and apparently a trace of salicylic acid.

The sesquiterpene contained in this oil is a slightly viscid liquid, having a pale straw colour and a delicate rose-like fragrance. Although it was not possible to obtain from it any solid derivative, such as the hydrochloride, nitrosochloride, nitrosite, or nitrosate, and thereby definitely characterise it, it is evidently not identical with either of the previously known optically inactive sesquiterpenes, humulene and limene (*Trans.*, 1895, **67**, 60, 780, and 1904, **85**, 416), and may therefore be regarded as a compound which has not hitherto been described. Its molecular refraction indicates that it belongs to the group of dicyclic sesquiterpenes with two ethylenic linkings.

***125. "Mobility of substituents in derivatives of β-naphthol." By John Theodore Hewitt and Herbert Victor Mitchell.**

The authors found that when *p*-nitrobenzenediazonium chloride was added to an alkaline solution of 1-bromo-2-naphthol, coupling immediately occurred. The resulting substance when purified was free from

halogen, and on analysis proved to be identical with *p*-nitrobenzeneazo-*β*-naphthol; the bromine atom had consequently been displaced by the benzene group. The generality of the reaction was shown by examining the behaviour of the corresponding chloro- and iodo-*β*-naphthols, whilst alkaline bromonaphthol was also treated with diazotised solutions of the following amino-compounds: *o*-, *m*-, and *p*-toluidines, *o*- and *m*-nitroanilines, 2 : 4-dinitroaniline, *p*-phenetidine, *o*- and *p*-aminobenzoic acids, *β*-naphthylamine, and the 6- and 8-monosulphonic derivatives of the latter base.

Incidentally, the acetyl-derivative of 1-bromo-*β*-naphthol was prepared; this proved to be a well-crystallising solid, m. p. 56°, and not an oil, as described by Canzoneri (*Gazzetta*, 1882, 12, 431).

The nitroso-group in nitroso-*β*-naphthol is also mobile, treatment with nitric acid furnishing 1 : 6-dinitro-2-naphthol.

Discussion.

Mr. W. A. Davis referred to his results, summarised in the Reports for 1900 to 1903 of the Committee of the British Association on Isomeric Naphthalene Derivatives, showing the mobility of a halogen atom in position 1 in *β*-naphthol under the influence of hydriodic acid or nitric acid. Halogen atoms in other positions in the nucleus were not affected, and the same was true of an *α*-halogen in a non-hydroxylated naphthalene nucleus. The sensitiveness of the *α*-halogen atom in the naphthol was to be attributed to the formation of an additive compound at the *αβ*-ethenoid linking, as was well illustrated in the case of nitric acid by the production of the nitro-bromo-keto-compounds.

Dr. Hewitt, in replying to the President, remarked that he had not encountered any statement concerning the displacement of halogen atoms by azo-groups. The product of the action of diazotised aniline on an alkaline solution of bromo-*β*-naphthol, though very tarry, evidently contained some benzeneazo-*β*-naphthol, since if nitrated in concentrated sulphuric acid solution a certain amount of *p*-nitrobenzeneazo-*β*-naphthol could be isolated.

Mr. Davis' experiments on the action of hydriodic acid on *α*-halogen-substituted *β*-naphthols seemed to be of a different nature, in that the compounds were reduced; it was not the direct replacement of negative atoms by other complex groups.

***126. "The decomposition of nitrocellulose." By Oswald Silberrad and Robert Crosbie Farmer.**

Great uncertainty has hitherto prevailed as to the products which result from the gradual deterioration of nitrocellulose. An exhaus-

tive examination of the decomposition products obtained on storage of 100 kilograms of gelatinised nitrocellulose for twenty-three weeks at 54—55° in a damp atmosphere led to the identification of the following products: ethyl nitrate, ethyl nitrite, ethyl alcohol, nitric and nitrous acids, ammonia, formic, acetic, butyric, dihydroxybutyric, oxalic, tartaric, *iso*saccharinic, and hydroxypyruvic acids. Carbohydrates were also present.

***127. "Note on gunpowder and bullets, made about 1641, recently discovered in Durham Castle." By Oswald Silberrad and William Slessor Simpson.**

For the materials for this investigation we are indebted to the Secretaries of this Society for putting us into communication with J. T. Johnson, Esq., of Durham School, who kindly forwarded samples of the bullets and gunpowder in question. The ammunition was found in a bucket which had been walled up in the roof of Durham Castle, probably having been placed there about 1641, when the Castle was armed against a Scottish raid.

The bullets consisted of roughly moulded spheres of lead of two different sizes, some being 1·5 cm. and others 1·8 cm. in diameter. On analysis they were found to consist of 99·17 per cent. of lead, and to contain a small quantity of iron and silver together with traces of bismuth, arsenic, and antimony.

The gunpowder, on analysis, was found to approximate closely in composition to the black powder now used in this country. In appearance, however, it differed widely from powder manufactured at the present day, the ingredients having been merely ground and mixed together, no attempt at granulation having been made.

	Analysis of powder from Durham Castle.		Proportions used at present time in this country.
	On sample.	On dry material.	
Potassium nitrate ...	73·99	74·81	75
Carbon...	14·71	14·87	15
Sulphur	9·98	10·09	10
Moisture	1·10		
	99·78		

These results are somewhat surprising, since the compositions used in this country during the seventeenth century all contained a much higher percentage of sulphur. It seems indeed probable that this powder was of Prussian origin, Prussian musket powder being the only explosive of this composition in use at that date.

The calorimetric value was determined by firing a charge at a density of loading 0·48 in a closed vessel suspended in a calorimeter.

The pressure recorded was 9·7 tons per sq. in., or 1478 atmospheres. The calorimetric value = 694 calories per gram.

This is in close agreement with the figure given by ordinary black powder.

The critical time of burning was determined at a density of loading of 0·230. The apparatus used was similar to that described by Sir Andrew Noble (*Phil. Trans.*, 1905, **205**, 201). The pressure was, however, taken on a crusher copper, and the time measured by means of a calibrated tuning-fork, which was simultaneously made to plot a record on a revolving drum.

The pressure recorded at this density was 4·51 tons per sq. inch, 687 atmospheres; ordinary black powder fired at this density gives a pressure of 686 atmospheres (Sir Andrew Noble, *Phil. Trans.*, 1905, **205**, p. 15). The critical time of burning observed was 0·0030 second. This is more rapid than that of the granulated powders now in use.

Unfortunately we were debarred from carrying out further experiments at higher densities owing to the small amount of material at our disposal.

128. "The constitution of acetone." By Millicent Taylor.

The action of sodium and of magnesium methyl iodide on acetone has been studied. So-called "sodium acetone," the product of the action of sodium on highly dilute acetone, is shown to consist of a mixture of caustic soda with a small proportion of sodium *iso*propyl-oxide; this is deduced from the percentage of sodium in the substance, and also from its behaviour with acid chlorides.

The only esters obtained by the action of chloroformic ester and *p*-nitrobenzoyl chloride on "sodium acetone" are ethyl *iso*propyl carbonate and *iso*propyl-*p*-nitrobenzoate respectively.

In no case was any indication of the formation of *iso*propenyl esters obtained. Moreover, in one case in which the yield of each product was determined, it was found that the total acid chloride employed was converted into acid anhydride, acid (or sodium salt), and *iso*propyl ester, leaving no possibility of the formation of other esters.

By the action of acetone on magnesium methyl iodide at the ordinary temperature and up to 140° no methane was liberated.

These results prove that acetone does not behave, either towards sodium or Grignard's reagent, as *iso*propenyl alcohol, $CH_3 \cdot C(OH) : CH_2$, and also that it does not contain any hydrogen directly replaceable by sodium under the conditions investigated.

129. "Diazo-derivatives of the mixed aliphatic aromatic ω-benzenesulphonylaminobenzylamines." By Gilbert Thomas Morgan and Frances Mary Gore Micklethwait.

A study of the action of nitrous acid on the benzenesulphonylaminobenzylamines, $NH_2 \cdot C_6H_4 \cdot CH_2 \cdot NH \cdot SO_2 \cdot C_6H_5$, showed that diazoimides could be obtained from the ortho- and meta-compounds, but not from the para-isomeride.

o-Nitrobenzylamine was converted successively into *benzenesulphonyl-o-nitrobenzylamine*, $NO_2 \cdot C_6H_4 \cdot CH_2 \cdot NH \cdot SO_2 \cdot C_6H_5$, and *ω-benzenesulphonyl-o-aminobenzylamine*, $NH_2 \cdot C_6H_4 \cdot CH_2 \cdot NH \cdot SO_2 \cdot C_6H_5$. This acylated diamine, when diazotised in strong hydrochloric acid, yielded a soluble diazonium salt; this substance, on treatment with aqueous sodium acetate, furnished a colourless mixed *diazoimide*,

$$C_6H_4 \begin{cases} CH_2 \\ N_2 \end{cases} > N \cdot SO_2 \cdot C_6H_5,$$

which, like the yellow aromatic para-diazoimides, is reconverted into the diazonium salt by the action of cold concentrated hydrochloric acid.

ω-Benzenesulphonyl-m-*aminobenzylamine* also gave rise to a soluble diazonium salt which, although not affected by aqueous sodium acetate, underwent condensation in the presence of excess of potassium bicarbonate and furnished a pale yellow *diazoimide* isomeric with the preceding compound.

These diazoimides owe their formation to the presence of hydrogen in the acylamino-group, $\cdot NH \cdot SO_2 \cdot C_6H_5$, for when this atom is replaced by methyl, condensation does not occur. The three benzenesulphonylaminobenzylamines and the methyl derivatives of the ortho- and meta-bases all yielded azo-β-naphthol derivatives.

130. "Influence of substitution on the formation of diazoamines and aminoazo-compounds. Part V. *s*-Dimethyl-4:6-diamino-*m*-xylene." By Gilbert Thomas Morgan and Arthur Clayton.

s-Dimethyl-4:6-diamino-m-*xylene* (m. p. 100—101°), which was obtained by the following series of operations:

$$C_6H_2Me_2(NH_2)_2 \longrightarrow C_6H_2Me_2(NH \cdot SO_2 \cdot C_6H_5)_2 \longrightarrow$$
$$C_6H_2Me_2(NMe \cdot SO_2 \cdot C_6H_5)_2 \longrightarrow C_6H_2Me_2(NHMe)_2,$$

yielded a colourless *dinitrosoamine*, $C_6H_2Me_2(NMe \cdot NO)_2$, and on treatment with *p*-nitrobenzenediazonium chloride gave rise to a small amount of the *aminoazo*-compound, $NO_2 \cdot C_6H_4 \cdot N_2 \cdot C_6HMe_2(NHMe)_2$, which separated from benzene either in brownish-grey crusts or in dark red prisms or diamond-shaped plates melting at 218°. This result shows that the symmetrical dimethylation of 4:6-diamino-*m*-xylene does not inhibit the production of an orthoazo-derivative.

131. "Improved apparatus for the determination of molecular weights." By Philip Blackman.

Isotonic solutions of two substances in the same solvent have equal vapour pressures at the same temperature. The state of equilibrium is represented by the equation:

$$\frac{m_1}{m_2} = \frac{w_1}{w_2} \cdot \frac{v_2}{v_1}$$

(w_1, w_2 are the weights of the substances of molecular weights m_1, m_2, dissolved in the solvent of volumes v_1, v_2 respectively). If two such solutions, maintained at the same temperature, have their vapours in communication by means of a suitable gauge, the indicator will remain stationary.

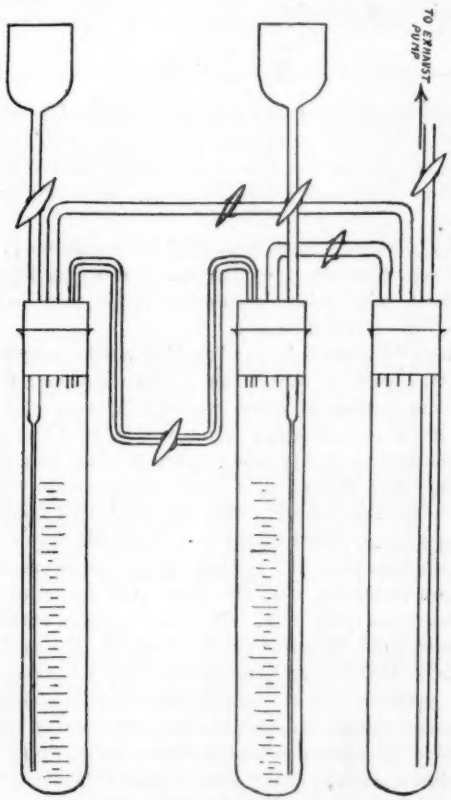
Unlike the previous method described by the author (*Trans.*, 1905, **87**, 1474; *Proc.*, 1905, **21**, 304), the success of which depends entirely on the regularity with which the solutions can be made to boil, the new method is free from this difficulty.

Two graduated boiling tubes, and another similar ungraduated tube, are each fitted with a three-holed rubber stopper; through each stopper of the graduated tubes passes a glass-stoppered dropping funnel, the lower end of which is drawn out to a fine point which reaches to the bottom of the tube (a piece of glass tubing, drawn out to a point, may also be fixed by a rubber connection to the end of the funnel just below the stopper). The two graduated boiling tubes are connected by a gauge fitted with a tap, a suitable liquid which is not affected by the vapour of the solvent being used as indicator. These two tubes are connected with the third tube by means of inverted U-pieces, also fitted with taps. The third tube is furnished with a glass-stoppered tube. The three tubes should be arranged in the form of a triangle, so that the apparatus is self-supporting (see figure).

By using equal weights of the substances whose molecular weights are to be compared, the calculations are considerably simplified; the above equation, by making $w_1 = w_2$, becomes $m_1/m_2 = v_2/v_1$.

The weighed quantities of the two substances (about 0·1—0·5 gram) are introduced into the graduated boiling tubes, the stoppers fixed in position, and the necessary connections effected. The taps in the funnels and gauge are kept closed, those in the U-tubes and remaining tube being left open; a little of the solvent is added to the funnels to ensure that no air may find its way into the apparatus. The third tube is then connected, by means of the stoppered tube, with a pump, and as high a vacuum as possible is obtained, after which the taps in the inverted U-pieces are closed. The solvent is now added from the

funnels, care being taken to avoid the introduction of air. The solvent must be added in sufficient quantity to cover the lower ends of the funnels. The substances must be left to dissolve, the process being hastened by slightly agitating the apparatus; this also assists in producing uniformity of concentration. The tap in the gauge is



cautiously opened (if care is not taken, the liquid serving as index may be forced into one of the solutions), and the movement of the indicator observed. This moves towards the tube in which the vapour pressure is smaller; consequently, if the solvent is added drop by drop from the funnel to that tube, a stage is reached at which the indicator remains stationary. Equilibrium having been attained, the volumes of the solutions are read off. More liquid may now be added to one of

the solutions, and equilibrium re-established by the addition of solvent to the other, when another reading of the volumes is taken. This process is repeated as often as is desirable.

It may be advantageous to maintain the solutions at equal temperatures by standing the apparatus in a trough of water.

The following table shows the results which were obtained. Equal weights of the substances were used in each experiment, the solvent was ether, and concentrated sulphuric acid was used as the index.

Substances. (Those marked with asterisks * were set as tests.)		Ratio m_1/m_2.	
		Theoretical.	Found.
p-Dibromobenzene (=m_1) ...	*p*-Chloronitrobenzene (=m_2)..	1·50	1·48
Bromo-α-naphthol (=m_1) ...	*p*-Chloronitrobenzene (=m_2)..	1·42*	1·41
Bromo-α-naphthol (=m_1) ...	1-Chloro-2 : 4-dinitrobenzene.	1·10*	1·13
Picric acid (=m_1).....	1-Chloro-2 : 4-dinitrobenzene.	1·13	1·12
2 : 4-Dinitrotoluene (=m_2) ...	*p*-Dibromobenzene (=m_1) ...	1·30*	1·32
2 : 4-Dinitrotoluene (=m_1) ...	α-Naphthylamine (=m_2).....	1·27*	1·25
p-Chloroaniline (=m_2)	1-Chloro-2 : 4-dinitrobenzene.	1·59*	1·55
p-Chloroaniline (=m_2)	*p*-Nitroaniline (=m_1)	1·08*	1·09
Iodoform (=m_1)	Hydrazobenzene (=m_2)	2·14	2·09
Hydrazobenzene (=m_2)	1-Bromo-2 : 4-dinitrobenzene.	1·34	1·35
1-Bromo-2 : 4-dinitrobenzene	Diphenylamine (=m_2)	1·46	1·50
β-Naphthylamine (=m_2).....	Picric acid (=m_1)	1·60	1·59
p-Chloroaniline (=m_2).....	β-Naphthylamine	1·12*	1·19
p-Toluidine (=m_2)	α-Naphthylamine (=m_1).....	1·33	1·34
m-Dinitrobenzene (=m_1).....	*p*-Nitrotoluene (=m_2)	1·22	1·21

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LIST OF FELLOWS, 1906.

The List of Fellows for 1906 is now in active preparation, and no change of address received after 31st July, 1906, can be included in it.

At the next Ordinary Meeting, on **Thursday,** July **5th, 1906, at 8.30 p.m.,** there will be a ballot for the election of Fellows, and the following papers will be read:

"Saponarin, a new glucoside, coloured blue with iodine." By G. Barger.

"The constitution of umbellulone." By F. Tutin.

"Electrolytic oxidation." By H. D. Law.

"The action of ethyl iodide and of propyl iodide on the disodium derivative of diacetylacetone." By A. W. Bain.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Thursday, 5th July, 1906.

Agar, Shelton Gottlieb,
Panorama House, Guernsey.

Assistant Public Analyst and Science (Junior) Lecturer. Assistant to the Public Analyst of Guernsey from June, 1895, to present date. Assistant Science Lecturer to Elizabeth College, Guernsey.

J. Bate Nickolls. F. J. S. Wyeth.
J. A. Williamson. *T. E. Thorpe.*
F. W. Toms.

Anderson, Robert,
Chester Road West, Sunderland.

Chemist. Chemist and Druggist.

Robert McClumpha. Geo. F. Merson.
Frank R. Dudderidge. *H. E. Stevenson.*
James Whittle.

Austin, Percy Corlett, M.A. (Cantab.),
Galway.

Research Assistant with Professor Senier, Queen's College, Galway. Late Scholar Emman. Coll., Camb.; Nat. Sciences Tripos (1901); worked at organic chemistry, Stuttgart, with Prof. Häussermann and Dr. Julius Schmidt (1902 and 1903); appointed Research Assistant Queen's College, Galway (Jan. 1904). Papers: with Dr. Jul. Schmidt: "Uebereinige Umsetzungen des Bis-Trimethyläthylen nitrosats" (*Ber.*, 1902, **35**, 3721), "Polymerie und Desmotropie beim Trimethyläthylen nitrosochlorid" (*Ber.*, 1902, **35**, 3727), "Ueber das Monobromtrimethyläthylen nitrosat" (*Ber.*, 1903, **36**, 1768), "Ueber das 2-Nitrophenanthrenchinon und seine Abkömmlinge" (*Ber.*, 1903, **36**, 3730);

with Prof. Senier : "Halides of the Acridines and Naphthacridines" (*Trans.*, 1904, **85**, 1196), "The Interaction of Acridines with Magnesium Alkyl Halides" (*Trans.*, 1905, **87**, 1469).

A. Senier. A. Jamieson Walker.
W. Sloan Mills. Sydney Young.
S. Ruhemann.

Berry, Arthur John,

5, University Gardens, Glasgow.

Student of Chemistry at Glasgow University. Since October, 1905, have been engaged in Research Work. I wish to keep in touch with results of recent research. Obtained First Class Certificate in Chemistry, March, 1904; Certificate of Merit in Metallurgical Chemistry, June, 1905; Certificate of Merit in Advanced Organic Chemistry, June, 1905.

W. Carrick Anderson. Charles E. Fawsitt.
Frederick Soddy. T. S. Patterson.
James Roberts, jun.

Bowie, William John,

97, North Road, West Bridgford, Notts.

Student. Four years' experience as assistant in the analytical laboratory of Messrs. Boots' works; 1 year in the bacteriological laboratory of Professor Fresenius in Wiesbaden. Took Ph.D. degree of Zürich University after 3 years' work with Prof. Werner. Dissertation, "Ueber Triamminkobaltiake."

Edward Francis. *Robert J. Caldwell.*
J. H. Johnston. *H. C. Sayer.*
Frank Lee Pyman. *W. C. Reynolds.*

Calam, Harold,

71, Cemetery Road, Beeston Hill, Leeds.

Analytical Chemist. Student at Yorkshire College (now Leeds University), 3 years (1900—1904). Ordinary B.Sc. (Vict.), 1903. B.Sc. (Vict.), 2nd Class, Hons. in Chemistry, 1904. Final A.I.C., 1905. Have been Assistant Chemist under West Riding of Yorkshire Rivers Board, Wakefield, since Feb., 1905.

Arthur Smithells. C. E. Whiteley.
J. B. Cohen. W. Lowson.
H. M. Dawson. H. T. Calvert.

Denton, John,

Horton Villa, Bradford.

Head Chemist and Chemist-Manager to Messrs. Wm. North and Co.,

Dyers, Bleachers, Mercerisers. Joint author of "The Analysis of Samples of Indigo containing notable amounts of Indirubin," *J. Soc. Dyers*, 1901, 17. Head Chemist and Chemist-Manager to Wm. North and Co., Dyers, Bleachers, and Sizers and Mercerisers of warps and hank cotton; previous to this, taken the Diploma Course in Chemistry and Dyeing at the Municipal Technical College, Bradford, gaining the full College Diploma and College Certificates; also First Prizeman in each year at the College (3 years). Some time Assistant in the Technical College Chemical Laboratory. Been with Wm. North and Co., as Head Chemist, nearly five years.

Walter M. Gardner. A. Batty Knaggs.
Barker North. Saml. F. Stell.

Franklin E. Robertson.

Drinkwater, Lionel John,

27, Stokenchurch Street, Fulham, S.W.

Schoolmaster. Recognised by Board of Education, and registered on Col. B. as a Teacher of Chemistry; Passed Honours Examination, Chemistry. Board of Education Chemistry to B.Sc. Lond. standard.

Will. T. Boone. Léon E. Walling.
S. F. Dufton. G. H. G. Plymen.

Percy Elford.

Eaton, Bertie James,

Kuala Lumpur, Federated Malay States.

Government Chemist, Federated Malay States. Three years Finsbury Technical College, Certificated Student. Two years Assistant in the Scientific and Technical Department, Imperial Institute. Late holder of Dorset Senior Science Scholarship. Four times holder of Dixon-Galpin University Extension Scholarships (Dorset); Associate of Institute of Chemistry (Branch E.); Inter. B.Sc. (Lond.).

Wyndham R. Dunstan. Chas. R. Darling.
Thomas A. Henry. Henry H. Robinson.
Ernest Goulding. Albert E. Andrews.

Geo. S. Blake.

Flürscheim, Bernhard,

Heatherlands, Fleet (Hants).

Ph.D. Research Chemist. The following contributions to Chemical Science: *J. pr. Chem.*, **66**, 16; **66**, 321; **68**, 345; **71**, 499. *Ber.*, **34**, 787.

Alexander Scott. James D. Kettle.
James Dewar. *Hugo Müller.*

J. Emerson Reynolds.

Gibbs, Reginald William Malyon,

(1) *Before July*, 1906, Hetty Villa, Cam Road, Chesterton, Cambridge;

(2) *From and after July*, 1906, The Grammar School, Spilsby, Lincolnshire.

Headmaster of Grammar School, Spilsby. (1) Studied Chemistry practically for 1½ years at the laboratory of Messrs. Helbing and Passmore, 63, Queen Victoria Street, E.C., from January, 1897, to June, 1898. (2) Taught Chemistry practically (*a*) at Larchfield, Helensburgh, N.B., September, 1899—June, 1900; (*b*) Weston, S. Marychurch, Torquay, January, 1902—March, 1903 (up to Standard of Army and Navy Entrance Examinations). (3) Hold degree of B.Sc (Lond.), October, 1905. (4) Shall hold degree of B.A. (Camb.) from June, 1906.

James D. Kettle. H. Helbing.
Harold F. F. Varley. *Peter MacEwan.*
Frederick B. Power.

Gregory, Thomas William D.,

82, Moorland Road, Burslem, Staff.

Instructor in Experimental Science, Pottery, and Mining Chemistry to Staffordshire Education Committee. Six years a student of Chemistry at Owens College, Manchester. Certificate of Applied Chemistry and Levinstein Exhibitioner of Owens College. Now Lecturer in Chemistry under the N. Staffordshire County Council. Joint author with Prof. W. H. Perkin, jun., of a paper on Hexamethyleneoctocarboxylic Acid, &c., published in the Society's *Transactions*, 1903, **83**, 780.

H. B. Dixon. William A. Bone.
W. H. Perkin, jun. Norman Smith.
D. L. Chapman.

Hedley, Edgar Percy,

6, Royal Terrace, West Kingstown, Co. Dublin.

Student engaged in research in Chemistry and Spectrography in the Royal College of Science, Dublin. Associate of the Royal College of Science, Dublin, in the Faculty of Applied Chemistry.

W. N. Hartley. A. O'Farrelly.
W. E. Adeney. James H. Pollok.
F. G. Donnan.

Hill, Arthur Edwin,

236, Willesden Lane, Brondesbury, N.W.

At present studying Chemistry under Professor Armstrong at City

and Guilds Central Technical College. Contributed paper on "New Form of Calcium Chloride Tube for Combustions."

Henry E. Armstrong.	Robert J. Caldwell.
Gerald T. Moody.	S. L. Courtauld.
William A. Davis.	M. O. Forster.

Hopkins, Frederick Gowland,

Stafford House, Newnham, Cambridge.

Reader in Chemical Physiology in the University of Cambridge; Lecturer of Emmanuel College. M.A. (Cambridge), M.B., D.Sc. (Lond.), F.I.C., F.R.S. Author of various contributions, chiefly dealing with physiological chemistry. *Phil. Trans.*, *Proc. Roy. Soc.*, *Journal of Physiology*, &c.

Thos. Stevenson.	Arthur W. Crossley.
Henry E. Armstrong.	M. O. Forster.
Bernard Dyer.	John Wade.

Hughes, John Gerard,

2, Canute Road, Southampton.

Chemist. Member of the Pharmaceutical Society. For some time Science Student at the Hartley University College under Mr. Brierley and Professor Boyd, also late Student in Pharmacy, Borough Analyst, &c., with Mr. W. B. Cowie in Edinburgh. Desiring admission to the Society for use of the Library and Current Literature on Analytical Chemistry.

Will. F. Mawer.	H. Wilson.
J. Brierley.	Wm. B. Cowie.
Harold W. Harrie.	*E. J. Jackman.*
Thomas A. Gerard.	*Maurice B. Jack.*

Jenkinson, Ernest Arthur,

Dauntsey Agricultural School, West Lavington, Wilts.

Schoolmaster. Joint Author, "Studies in the Camphane Series. Part XII" [Trans. Chem. Soc., 1903]. First Class Assoc. in Chemistry, Royal Coll. Sci., London, 1900. Teaching Scholar in Chemistry, Royal Coll. Sci., London, 1900—1902. Demonstrator and Lecturer, Northern Polytechnic Institute, 1901—1902, and Science Master, Dauntsey Agricultural School, 1902—1906.

William A. Tilden.	Chapman Jones.
M. O. Forster.	G. T. Morgan.

James C. Philip.

Macdonald, Thomas,

North Frodingham, Driffield, Yorkshire.

General Manager of Manure Works. I have been a student for four sessions in the Glasgow and West of Scotland Technical College, and have prizes and certificates for Chemistry, and have also been Chemist in various works for about five years before present position.

A. Humboldt Sexton. G. G. Henderson.
Thomas Gray. *R. R. Tatlock.*
R. T. Thomson.

Martin, Frederick James,

Passagem de Marianna, Minas, Brazil.

Assayer and Assistant Reduction Officer. I studied Chemistry at the Camborne School of Mines for two sessions, 1897—1898, made many analyses and investigations under the direction of Mr. J. J. Beringer. Was engaged in 1899 as an Assistant in the Reduction Department (the work being chiefly in connection with a Chemical process for the extraction of gold) of the St. John Del Rey Gold Mines of Brazil, Ltd. I am now Assayer and Assistant Reduction Officer at the works of the Ouro Preto Gold Mines of Brazil, Ltd., having been in the employ of this Company, first as an assistant in the same department, since 1903. I am much interested in Chemistry and Chemical Engineering.

Frederick L. Wilder. J. J. Beringer.
Arthur J. Bensusan. H. R. Beringer.
H. W. Hutchin.

Mills, Herbert Arthur,

Waverley, Bloomfield Gardens, Bath.

Chemist. Pharmaceutical Chemist; M.P.S. Have studied Chemistry at Technical Schools, private tuition, and under the late W. Watson-Will for over a year at the Metropolitan College of Pharmacy, and am desirous of keeping in touch with Chemical world.

Harry Lucas. F. Filmer De Morgan.
David J. Williams. *Frederick B. Power.*
Peter MacEwan.

Mummery, William Rest,

The Firs, Shenfield, Essex.

Analytical Chemist. I have studied Theoretical and Practical Chemistry at King's College, London, under Professor Millar Thomson (1901—1904); engaged in Analytical Chemistry for eighteen months

in the Laboratories of Mr. A. C. Chapman, F.I.C., F.C.S.; elected an Associate of the Institute of Chemistry in April, 1906.

John M. Thomson. D. Northall-Laurie.
Herbert Jackson. Otto Hehner.
Patrick H. Kirkaldy. Alfd. C. Chapman.
W. P. Skertchly.

Palmer, Arthur Charles,

17, Wansbeck Gardens, West Hartlepool.

Assistant Science Master, Technical College, West Hartlepool. B.Sc., London, 1905 (1st Division, Chemistry, Physics, and Mathematics). Engaged in teaching Chemistry since 1896, Registered in "Column B" in 1904.

M. O. Forster. J. Archyll Jones.
G. T. Morgan. J. W. Patterson.
C. F. Baker.

Pearse, Leonard Edward Beard,

79, Gordon Road, Ealing, W.

Metallurgical Chemist and Assayer. Student for 3 years at the Royal School of Mines, London. Two years Assistant Chemist and Assayer to Mr. G. T. Holloway, 57, Chancery Lane, W.C. Appointed May, 1906, as Metallurgical Chemist at Lead Rolling Works, Calcutta.

W. Gowland. David A. Louis.
George T. Holloway. William T. Burgess.
W. E. F. Powney. W. H. Merrett.
E. O. Courtman.

Pendlebury, Harold Lawson,

4, Wentworth Street, Bolton, and carrying on business at 22, Blackfriars Street, Salford, Manchester.

Analytical and Consulting Chemist. Analyst, studied Honours at Manchester Tech. School. Assistant, Bolton Borough Analyst. Assistant (Chief) to the late Geo. H. Hurst, Esq., F.C.S.

Charles A. Fogg. H. Rostron.
Ernest Boardman. *T. M. Nightingale.*
Jno. L. Whiteside.

Pennymore, Percy George,

Eskbank Iron and Steel Works, Lithgow, New South Wales.

Metallurgist and Blast Furnace Manager. Fourteen years' practical

Laboratory experience, of which six years as Chief Analytical Chemist to the Blaenavon Co., Ltd.

J. Jas. Morgan. R. W. Atkinson.
Lawrence Dufty. *Geo. R. Thompson.*
Pattinson B. Melmore.

Pickles, Samuel Shrowder, B.Sc. (Vict.).

Research Chemist at the Imperial Institute, South Kensington. B.Sc. (Victoria University, Manchester). 1st Class Honours Chemistry. For two years private research Assistant to Prof. W. H. Perkin, jun., F.R.S. Joint author with Prof. Perkin of the following papers: "The Reduction of *iso*Phthalic Acid," "Experiments on the Synthesis of the Terpenes. Part II," "Experiments on the Synthesis of the Terpenes. Part III," and several other papers published in the Proceedings of the Chemical Society.

Wyndham R. Dunstan. J. F. Thorpe.
Harold B. Dixon. R. S. Hutton.
D. L. Chapman. W. H. Perkin, jun.

Pye, Thomas Ebenezer,

"West View," Summersdale, Chichester.

Engineer and Manager, The City of Chichester Gas Company. Assistant Lecturer and Demonstrator under Wm. F. Lowe, Esq., F.I.C., A.R.S.M., &c., at the South Kensington Science and Art Department Chemistry Class at Chester. Lecturer to the Chester Society of Natural Science on "The Extraction of Ammonia from Blast Furnace Gases." Official Tester and Gas Analyst for Chester Gas Co. for seven years, and for Shrewsbury Gas Co. for four years. Author of The Manufacture and Purification of Coal-gas "for Gas Students," published by the *Journal of Gas-lighting*, Vols. LIX, LX, LXI, LXII, including two articles on "The use of Oxygen as an aid to Lime Purification, and its Behaviour in the Lime Boxes." Author of numerous popular lectures and pamphlets on "The Chemistry of Gas Combustion."—Five of the Chemistry Articles for Gas Students are herewith submitted.

W. F. Lowe. Norton H. Humphrys.
Vivian B. Lewes. H. Leicester Greville.
John Bairstow. *A. J. Greenaway.*

Rawles, Walter Hansen,

81, Lewisham High Road, London, S.E.

Analytical Chemist. I studied Chemistry for four years at the Technical College, Finsbury, E.C., under Professor Meldola, F.R.S., &c.,

and I now hold the position of Analytical Chemist to Peak, Frean & Co., Ltd., Biscuit Manufacturers, Bermondsey, S.E.

R. Meldola. Lewis Eynon.
John Castell-Evans. Harley F. Knight.
Edward W. Bealey.

Salmon, Frederick John,

c/o Princess Estate and Gold Mining Co., P.O. Box 112, Roodepoort, S.A.

Technical Chemist. Studied four years at the Central Technical College, S. Kensington, and took the Diploma in Technical Chemistry. Worked six months in the Laboratory of G. T. Holloway, Chemist and Metallurgist, of Chancery Lane. Now engaged in Cyanide work on the Rand.

James Moir. Gerald T. Moody.
Henry E. Armstrong. William A. Davis.
Robert J. Caldwell.

Seaber, Willie Macro,

Firdale, Sheen Lane, East Sheen.

Analytical Chemist, at present engaged in Eley Bros.' Cartridge Works. Bachelor of Science (Lond.); about four years with Leo Taylor, F.I.C., Public Analyst for Hackney; three months with R. A. Cripps, F.I.C., Public Analyst for Bournemouth; one year at University Tutorial College, Holborn.

Percy Edgerton. J. W. Shepherd.
B. S. Evans. *Arthur J. Starey.*
Harold W. Harman.

Senior, John,

Sizing Hill, Batley Carr, Dewsbury.

Manager and Chemist to Messrs. Joseph Senior and Sons, Soap Works, Dewsbury. I have been a student at the Dewsbury Technical School, in the Chemistry and Physics Departments, for the past nine years. Have passed Board of Education Examinations in Theory and Practical Chemistry (Honours, Organic and Inorganic). I wish to keep my chemical knowledge up-to-date.

Herbert John Taylor. Isaac Patchett.
Robert Gawler. R. S. Cahill.
C. E. Womersley. *Joseph Brown.*
Thos. Holyate.

Shepherd, Arthur Burton,

18, Stafford Street, Hull.

Analytical Chemist. A four years' Course in Chemistry at Yorkshire College, Leeds; also Bacteriology at Leeds Medical School. Three years Assistant to Mr. T. Fairley, Leeds City and County Analyst. Two years Chemist to British Oil and Cake Mills, Hull. Degrees obtained: B.Sc. (Vict.), Hons. Chem., F.I.C.

Arthur Smithells. H. M. Dawson.
Thomas Fairley. C. E. Whiteley.
J. B. Cohen. W. Lowson.

B. A. Burrell.

Smith, Fred,

Cliff House, Bruntcliffe.

Analyst at Cliffe Mills, and desires to join the Chemical Society in order to be brought into touch with all recent work.

T. W. Lockwood. William W. Tunnicliffe.
Saml. F. Stell. *Walter M. Gardner.*

B. North.

Stirimer, Emanuel George,

Park House, Margery Park Road, Forest Gate.

Manufacturing Chemist. Received general education, and attended special classes in Chemistry at Central Foundation School, Finsbury. Studied Inorganic and Organic Chemistry (Theoretical and Practical) for 2¼ years under Mr. E. G. Clayton, F.C.S., F.I.C., and for 1 year at the West Ham Technical Institute under Messrs. G. Dean, M.A., F.C.S., and F. H. Streatfeild, F.C.S.

Edwy G. Clayton. F. Henry Streatfeild.
George Dean. *F. G. Adair Roberts.*

John Castell-Evans.

Treble, Richard Lumley,

The School Lodge, Cranbrook, Kent.

Schoolmaster. B.Sc., Durham, in Mathematics and Chemistry; late Exhibitioner in Science at the Armstrong College, Newcastle-on-Tyne, and Freire-Marreco Medallist in Chemistry; at the present time Senior Science Master in the Cranbrook Grammar School (1903—1906), previously Science Master in the Newbury Grammar School (1900—1902), and in the Market Harborough Grammar School (1899—1900).

P. Phillips Bedson. W. H. Bentley.
F. C. Garrett. H. R. Rogers.

H. G. F. Micklewright.

Turnbull, Robert Hutchison,

Messrs. MacAndrews and Forbes Co., Smyrna, Turkey-in-Asia.

Chemist. Eight years with Messrs. Nobel's Explosives Co., Ltd., as analytical, research, and superintending chemist. At present, Chief Chemist to the MacAndrews and Forbes Co., New York and Smyrna. Associate of the Glasgow Technical College. Fellow of the Institute of Chemistry.

G. G. Henderson. A. Humboldt Sexton.
Thomas Gray. *T. S. Patterson.*
Charles E. Fawsitt.

Watts, James Neil,

P. O. Eikenhof, Johannesburg, South Africa.

Principal of Government School, Transvaal. English Board of Education, Elementary and Advanced Certificate in Theoretical and Practical Chemistry, Hygiene, and Physiography. Distinction Certificate University Lectures on Geology (I wish to receive the Society's Publications and keep *au courant* with modern Chemistry).

Arthur C. Claudet. Robt. G. Grimwood.
Arthur J. Chapman. *W. J. Dibdin.*
R. Grimwood.

Wightman, Charles,

43, Portland Place, London, W.

Merchant. Have been connected with Chemical Manufacturing for more than forty years.

M. O. Forster. Edward Divers.
A. Gordon Salamon. Julian L. Baker.
R. Meldola.

Wren, Henry,

22, Stapleton Hall Road, Stroud Green, N.

Lecturer on Chemistry. "Synthese von Arylnitromethanen u. symmetrischen Stilbenderivaten." W. Wislicenus and H. Wren, *Ber.*, **38**, 502.

A. Vernon Harcourt. John Watts.
H. Brereton Baker. N. V. Sidgwick.
Andrea Angel.

Young, George,

38, Havelock Street, Sheffield.

Science Master, Central Secondary School, Sheffield. Bachelor of Arts, Royal University of Ireland; Bachelor of Science, University

of London. Science Master in School of Science, Central and Secondary School, Sheffield, nine and a half years. Lecturer and Teacher in Hygiene and Sanitary Science in Evening Department of Central Secondary School, Sheffield, ten years. Assistant Lecturer in Electrical Engineering, Technical Department of University College, Sheffield, seven years.

L. T. O'Shea. Fredk. Cowling.
Chas. Bradshaw. Morton E. Wager.

Walter N. Edwards.

The following Certificates were authorised for presentation to ballot by the Council under Bye-Law I (3):

Hertz, Dr. Charles H.,
Chapel Hill, N.C., U.S.A.

Professor of Chemistry, University of North Carolina. Researches on Double Halides of Lead and Potassium, Mixed Double Halides of Platinum and Potassium, Study of the Constitution of Inorganic Compounds (with A. Werner, of Zürich), Ph.B., Univ. of Georgia, Ph.D., Johns Hopkins University.

Francis P. Venable. F. W. Clarke.
Ira Remsen. *J. W. Mallett.*

F. P. Dunnington.

Sanyal, Surendra Prasad,
Majhowli Raj, Gorakhpur Dt., U.P., India.

Private Secretary to the Rajah Bahadur of Majhowli. Took the B.A. degree in Physical Science, and then specialised in Chemistry, taking the 2nd D.Sc. (M.A.) in that subject at the Allahabad University. Is desirous of being in touch with modern improvements in Chemistry.

B. M. Mukerjee. A. Sanyal.

P. P. Phillips.

Sime, Allan,
Kingston, Jamaica.

Analyst. For 4½ years assistant to H. H. Cousins, Esq., in the Analytical Department, Government Laboratory, and Sugar Experiment Station, Kingston, Jamaica.

H. H. Cousins. H. S. Hammond.
J. H. Roberts. *A. D. Hall.*

Wortley, Edward Jocelyn,

Rectory, Half-way Tree, Jamaica.

Assistant Island Chemist of the Government Laboratory, Jamaica. Second Assistant Chemist and Instructor in Analytical Chemistry to Agricultural Students, 1902—1905; appointed Assistant Island Chemist in August, 1905; these appointments held at Government Laboratory, Jamaica.

H. H. Cousins. H. S. Hammond.
J. H. Roberts. *A. D. Hall.*

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 18/7/06

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 313.

Thursday, July 5th, 1906, at 8.30 p.m., Professor R. MELDOLA, F.R.S., President, in the Chair.

Certificates were read for the first time in favour of Messrs.:

Reginald de Vere Cornwall, Medical and Public Health Dept., Salisbury, Rhodesia, S. Africa.
Henry Ernest Crocker, 452, Slade Road, Gravelly Hill, Birmingham.
James Herbert Dinwoodie, Johannesburg.
Gopal Chandra Sen, M.A., 23, Bond Street, Leeds.

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected:

Shelton Gottlieb Agar.
Robert Anderson.
Percy Corlett Austin, M.A.
Arthur John Berry.
William John Bowis, Ph.D.
Harold Calam, B.Sc.
John Denton.
Lionel John Drinkwater.
Bertie James Eaton.
Bernhard Flürscheim, Ph.D.
Reginald William Malyon Gibbs, B.Sc.
Thomas William D. Gregory.
Edgar Percy Hedley.
Charles H. Hertz, Ph.D., Ph.B.
Arthur Edwin Hill.
Frederick Gowland Hopkins, M.A., M.B., D.Sc., F.R.S.
John Gerard Hughes.
Ernest Arthur Jenkinson.
Thomas Macdonald.
Frederick James Martin.
Herbert Arthur Mills.
William Rest Mummery.
Arthur Charles Palmer, B.Sc.
Leonard Edward Beard Pearse.
Harold Lawson Pendlebury.
Percy George Pennymore.
Samuel Shrowder Pickles, B.Sc.
Thomas Ebenezer Pye.
Walter Hansen Rawles.
Frederick John Salmon.
Surendra Prasad Sanyal, D.Sc.
Willie Macro Seaber, B.Sc.
John Senior.
Arthur Burton Shepherd, B.Sc.
Allan Sime.
Fred Smith.
Emanuel George Streimer.
Richard Lumley Treble, B.Sc.
Robert Hutchison Turnbull.
James Neil Watts.
Charles Wightman.
Edward Jocelyn Wortley.
Henry Wren.
George Young, B.A. B.Sc.

Of the following papers, those marked * were read:

***132. "Saponarin: a new glucoside coloured blue with iodine." By George Barger.**

Dissolved in the cell sap of the leaf epidermis of various plants, there occurs a substance which is coloured blue by iodine, and which is known to botanists as "soluble starch." This substance has been isolated from *Saponaria officinalis*, and is a glucoside; the name saponarin is suggested for it.

Saponarin crystallises in microscopic needles melting at 231—232°, and having the composition $C_{21}H_{24}O_{12},2H_2O$. The glucoside dissolves in alkalis with a yellow colour, gives with ferric chloride a reddish-brown coloration, and with iodine a substance closely resembling that formed from starch.

Ennea-acetyl saponarin, $C_{21}H_{15}O_{12}(C_2H_3O)_9$, melts at 183—185° and crystallises in needles.

Acids hydrolyse saponarin, thus:

$$C_{21}H_{24}O_{12} + H_2O = C_6H_{12}O_6 + C_{15}H_{14}O_7,$$

yielding glucose and vitexin, a colouring matter obtained by A. G. Perkin from a New Zealand dye wood (*Trans.*, 1898, **73**, 1030, and 1900, **77**, 416).

At the same time another colouring matter is formed, apparently isomeric with vitexin, or closely related to it, for which the name saponaretin is suggested. Vitexin and saponaretin both yield phloroglucinol and *p*-hydroxyacetophenone on boiling with caustic potash. Molecular weight determinations of vitexin and of acetyl vitexin prove that Perkin's formula, $C_{21}H_{20}O_{10}$, must be changed to $C_{15}H_{14}O_7$. Vitexin differs therefore from apigenin by two molecules of water, and probably is a flavanone derivative containing either a reduced pyrone ring or a reduced phloroglucinol nucleus. It would be a representative of a new class of colouring matters to which scoparin, which Perkin regards as methoxy-vitexin, would also belong.

Discussion.

The President asked whether the new glucoside was widely distributed in the vegetable kingdom, and whether it was contained in any considerable quantity in any particular plant. He also asked whether the isomeride of vitexin was, in the author's opinion, to be regarded as a natural product, or whether it resulted from the isomerisation of vitexin during the hydrolysis of the glucoside. He considered that Dr. Barger had satisfactorily established the identity of the product of hydrolysis of his glucoside with vitexin, and that

he had also established the formula of the latter compound. He considered that the author had made an important contribution to plant chemistry.

Mr. Grant Hooper said that in the microscopic examination of vegetable substance, traces of what had hitherto been regarded as soluble starch were not infrequently observed. He would like to know whether Dr. Barger had detected and identified the interesting glucoside which he had just shown them in substances other than those from which he had isolated the new compound.

Dr. Barger, in reply, said that saponarin, which is optically active, occurs in about twenty plants; one of the richest of these, namely, *Saponaria*, contains less than 1 per cent. of the weight of dry leaves. Saponaretin is a product of secondary decomposition; vitexin is formed from the pure glucoside.

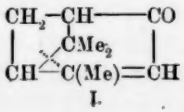
***133 "The constitution of umbellulone." By Frank Tutin.**

The ketone, umbellulone, was isolated from the essential oil of *Umbellularia Californica* by Power and Lees (*Trans.*, 1904, **85**, 629), who showed it to possess the formula $C_{10}H_{14}O$.

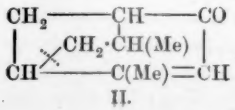
The behaviour of umbellulone towards certain reagents was further studied by Lees (*Trans.*, 1904, **85**, 639), and its investigation has been continued by the present author.

Umbellulone, on oxidation, yields a *saturated keto-acid*, $C_9H_{14}O_3$ (m. p. 102°), called *umbellulonic acid*, which, on distillation under suitable conditions, is partially converted into an *unsaturated lactone*, $C_9H_{12}O_2$ (b. p. 217—220°). This lactone, on hydrolysis, yields umbellulonic acid, and is produced by the elimination of water from the enolic modification of the keto-acid. On oxidation, a polymethylene dicarboxylic acid, *umbellularic acid*, $C_8H_{12}O_4$ (m. p. 120—121°), is obtained, which is remarkably stable.

By the bromination of umbellulone, and subsequent distillation of the products, *p*-cymene was obtained, together with substances containing bromine. It would therefore appear that the molecule of umbellulone has a structure capable of yielding this hydrocarbon without undergoing any profound change. The only formulæ which offer a satisfactory explanation of the behaviour of umbellulone on oxidation and on bromination are the following:



I.



II.

Both these substances, through the rupture of the bridge by the addition of hydrogen at the point indicated by the dotted line, would give compounds capable of yielding *p*-cymene. Formula I represents a keto-pinene, which would yield, on oxidation, a dimethyltetramethylene dicarboxylic acid, identical or stereoisomeric with the norpic acid obtained by the oxidation of pinene. On the other hand, the compound represented by formula II would yield 1-methylpentamethylene 3 : 5-dicarboxylic acid.

It is considered most probable that formula II represents the constitution of umbellulone.

Discussion.

Dr. Power congratulated Mr. Tutin on the accomplishment of this excellent work. He thought the evidence brought forward was so complete as to leave no doubt respecting the correctness of the constitutional formula assigned to umbellulone by Mr. Tutin. It was of interest to note that only one other ketone possessing the same empirical formula as umbellulone, namely, carvone, had been observed to occur in nature, but this had a very different constitution.

***134. "The action of ethyl iodide and of propyl iodide on the disodium derivative of diacetylacetone." By Alexander William Bain.**

As the result of the action of ethyl iodide on the disodium derivative of diacetylacetone, suspended in alcohol, the following substances have been obtained :

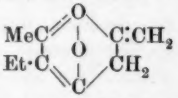
(1) Dimethyldiethylpyrone, $C_{11}H_{16}O_2$ (m. p. 64°).

(2) Dimethylethylpyrone, $C_9H_{12}O_2$ (m. p. 58°).

Each forms a hydrochloride and a platinichloride.

(3) Diethyldiacetylacetone, $C_{11}H_{18}O_3$.

(4) A compound, $C_9H_{12}O_2$ (m. p. 66—67°, b. p. 289°), isomeric with dimethylethylpyrone, to which the formula



is ascribed. This compound on boiling with concentrated hydrochloric acid yields dimethylethylpyrone hydrochloride, and by the action of sodium hydroxide solution is changed into an orcinol derivative.

By the action of propyl iodide on the disodium derivative of diacetylacetone, the author has obtained dimethylpropylpyrone, $C_{10}H_{14}O_2$, and also an isomeric substance which possesses similar properties to the corresponding ethyl compound.

135. "A possible source of error in Stas's nitrogen ratios." By Robert Whytlaw Gray.

Stas's higher value for the atomic weight of nitrogen is supported by very little evidence.

Not only do the researches of Rayleigh, Leduc, D. Berthelot, Guye, and the author confirm the lower value, but an indirect comparison of the atomic weights of nitrogen and silver from the results of Marignac, Scott, and Richards leads to the same result.

By assuming similar errors in the ratio $Ag : NH_4Cl$ and $Ag : NH_4Br$ of Stas as those found for the ratio $Ag : NaCl$ by Richards and Wells, the value for nitrogen deduced is 14·011. The possible sources of error in the other ratios are discussed.

136. "Electrolytic oxidation." By Herbert Drake Law.

On oxidising benzoin by the electrolytic method, three products are formed, namely, benzil, benzaldehyde, and benzoic acid, as shown by the following equations:

$$C_6H_5\cdot CH(OH)\cdot COC_6H_5 + O = C_6H_5\cdot CO\cdot COC_6H_5 + H_2O,$$
$$C_6H_5\cdot CH(OH)\cdot COC_6H_5 + O = C_6H_5\cdot CHO + C_6H_5\cdot CO_2H.$$

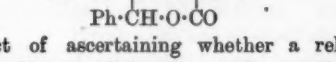
In addition to these, however, a certain amount of tarry matter is always obtained. This formation of complex tarry matter is a property of high potential discharge at the anode, and always takes place in the case of unsaturated compounds. The amount of any of these products which is formed is influenced very largely by the conditions of the experiment. Thus, strongly acid solutions promote the formation of tar, but none is observed when the anodic discharge is kept low. Similar experiments conducted with compounds resembling benzoin gave results agreeing with the above. Thus, cuminoin on being oxidised electrolytically forms cumic acid, cuminol, and tar. Furoin forms furil and tar, benzfuroin gives benzoic acid and tar, whilst anisoin and piperonyloin yield nothing but complex resinous matter of unknown constitution.

137. "The ethyl esters of acetonyloxalic and acetophenyloxalic acids and the action of ethyl oxalate on acetanilide and its homologues." By Siegfried Ruhemann.

The research was suggested by a note of Claisen's (*Ber.*, 1891, **24**, 128) that ethyl sodioacetonyloxalate, on boiling with glacial acetic acid, yielded the sodium compound possessing the empirical formula

$C_5H_8O_3Na$. This is violet, as is the substance which Ruhemann and Merriman (*Trans.*, 1905, **87**, 1383) obtained in the course of their investigation on the reaction between phenylpropiolyl chloride and sodioacetylacetone. The compounds which are produced by the condensation of aromatic aldehydes with the ethyl esters of acetonyloxalic and acetophenyloxalic acids react with aniline and its homologues to yield yellow substances, which are constituted according to the type:

With the object of ascertaining whether a relationship exists between these yellow substances and xanthoxalanil, which W. Wislicenus and Sattler (*Ber.*, 1891, **24**, 1245) obtained, although in an impure form, from acetanilide and ethyl oxalate, the author has repeated the experiments of these chemists and has prepared xanthoxalanil in a pure state by crystallisation from nitrobenzene; its constitution is expressed by the formula



Similar compounds have been prepared by using, instead of acetanilide, aceto-*p*-toluidide (see Wislicenus and Sattler, *loc. cit.*), aceto-*o*-toluidide, and aceto-α-naphthalide. These substances differ from each other, especially in colour and solubility. Xanthoxalanil is deep orange and sparingly soluble in nitrobenzene, xanthoxalo-*p*-toluidide, $C_{22}H_{16}O_5N_2$, is lighter in shade and more soluble, whilst the corresponding ortho-compound is canary-yellow and readily dissolves in this solvent; finally, xanthoxalo-α-naphthylanil, $C_{28}H_{16}O_5N_2$, is also yellow, but dissolves in glacial acetic acid.

138. "An oxidation product of indigotin."

By Arthur George Perkin.

It has been shown by Sommargua (*Annalen*, 1879, **195**, 305) that, on sublimation under reduced pressure, refined natural indigo yields pure indigotin; again, Bloxam (*Trans.*, 1905, **87**, 982) has found that this is the case with the commercial synthetical product. With limited access of air, however, pure indigotin and also these commercial varieties give a small quantity of a yellow sublimate which crystallises in needles, m. p. 258—259°, is very sparingly soluble in alcohol, and can be distilled without appreciable loss. It appears to have the formula $C_{15}H_8O_2N_2$ (Found, C = 72·59; H = 3·17; N = 11·59 per cent.), is very resistant to acid oxidising agents, but on boiling with strong potassium hydrate solution gives anthranilic acid. When treated in boiling glacial acetic acid solution with hydriodic acid, an unstable *hydriodide*, forming colourless, prismatic needles (Found, N =

7·42 per cent.), is produced; this, on treatment with water, splits off hydriodic acid and is reconverted into the substance $C_{15}H_8O_2N_2$; it is therefore probably the salt of an unstable reduction product of the latter. On reduction with tin and hydrochloric acid, a *compound*, $C_{15}H_{12}ON_2$ (Found, C = 76.33; H = 5·34; N = 11·88 per cent.), crystallising in colourless needles, m. p. 190—193°, is formed, which on oxidation is reconverted into the substance $C_{15}H_8O_2N_2$. A trace of indole is also formed during the reduction. By the prolonged action of hydriodic acid, a compound crystallising in yellow needles, m. p. 200—203°, is produced, which can also be reoxidised to the original product. The author hopes to devise a better method for preparing this yellow compound, as hitherto, with much labour, only 8 grams of the pure substance could be obtained from 2 lb. of indigo.

139. "Indigo-yellow." By Arthur George Perkin.

In a previous communication (*Proc.*, 1904, **20**, 172) it was shown that the yellow colouring matter usually present in Java indigo is kampherol. Examination has now shown that it is derived from a glucoside present in the leaves of the Java and Natal indigo plants (*Indigofera arrecta*), which is probably hydrolysed during the fermentation process. The material employed was chiefly the air-dried Natal leaf. This glucoside, for which the name *Kampheritrin* is proposed, has the formula $C_{27}H_{30}O_{14}$ (Found, after being dried at 100°, C = 56·00; H = 5·27 per cent.); the air-dried substance contains $3\frac{1}{2}$ mols. of water (Found, H_2O = 9·79 per cent.). It crystallises in colourless needles, which are sparingly soluble in water, is very nearly devoid of tinctorial properties, and, when heated, congeals together at 190—192° and melts at 201—203°. It is hydrolysed by acids according to the equation

$$C_{27}H_{30}O_{14} + 4H_2O = C_{15}H_{10}O_6 + 2C_6H_{14}O_6$$

into kampherol (Found, $C_{15}H_{10}O_6$ = 49·19 per cent.) and rhamnose, identified by means of its osazone. Analyses of the kampherol thus obtained, m. p. 275—277° (Found, C = 63·01; H = 3·68 per cent.), and its acetyl compound, m. p. 181° (Found, C = 60·77; H = 4·43 per cent.), were made for purposes of confirmation. By the method employed, 1·5 per cent. of the glucoside was isolated, but considerably more of this is really present, as 2 per cent. of an impure kampherol contaminated with a reddish-brown substance, probably the so-called "indigo-brown," could be obtained by hydrolysing the aqueous extract of the leaf.

140. "1 : 3-Diphenylbarbituric acid and some coloured derivatives. Synthesis of 1 : 3-diphenyluric acid." By Martha Annie Whiteley.

1 : 3-*Diphenylbarbituric acid*, $CO<^{NPh\cdot CO}_{NPh\cdot CO}>CH_2$, prepared by heating malonyl chloride and carbanilide or malonic acid, phosphorus oxychloride and carbanilide in chloroform solution, forms colourless, prismatic needles and melts at 238°; the *dimethyl* derivative,

$$CO<^{NPh\cdot CO}_{NPh\cdot CO}>CMe_2,$$

crystallises in colourless needles, melts at 230°, and sublimes at a slightly higher temperature; the iso*nitroso*-derivative (*diphenylvioluric acid*), $CO<^{NPh\cdot CO}_{NPh\cdot CO}>C<^{NH}_{O}$, crystallises in colourless needles, melts and decomposes at 227°, and yields the red or violet-salts characteristic of this type of compound; the *potassium*, *aniline*, and *piperidine* salts were prepared; the *acetyl* derivative, $C_{16}H_{10}O_3N_3\cdot OAc$, crystallises in colourless prisms and melts at 245°. 1 : 3-*Diphenyl*-5-*aminobarbituric acid* (1 : 3-*diphenyluramil*), obtained by reducing diphenylvioluric acid, forms colourless crystals, melts and decomposes at 195°, and condenses with potassium cyanate to form 1 : 3-*diphenyl*-ψ-*uric acid*,

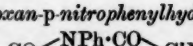
$$CO<^{NPh\cdot CO}_{NPh\cdot CO}>CH\cdot NH\cdot CO\cdot NH_2,$$

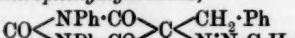
which crystallises in colourless prisms, melts and decomposes at 217°, and on boiling with hydrochloric acid yields 1 : 3-*diphenyluric acid*, $^{NPh-CO\cdot C\cdot NH}_{CO\cdot NPh\cdot C\cdot NH}>CO$, which crystallises in colourless needles, softens at 238°, but does not melt at 306°.

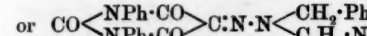
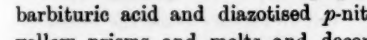
1 : 3-Diphenylbarbituric acid condenses readily with aromatic aldehydes or diazonium chlorides, and the resulting compounds are of a bright yellow or orange colour. 5-*Benzylidene*-1 : 3-*diphenylbarbituric acid*, $CO<^{NPh\cdot CO}_{NPh\cdot CO}>C{:}CHPh$, forms pale yellow, prismatic needles from most of the ordinary solvents, crystallises from acetone or ethyl acetate in a mixture of colourless and yellow needles, each form melting sharply at 214°, and yielding on reduction 5-*benzyl*-1 : 3-*diphenylbarbituric acid*; 5-*cinnamylidene*-1 : 3-*diphenylbarbituric acid*,

$$CO<^{NPh\cdot CO}_{NPh\cdot CO}>C{:}CH\cdot CH{:}CHPh,$$

forms bright yellow needles and melts and decomposes at 268°. 1 : 3-*Diphenylalloxanphenylhydrazone*, $CO<^{NPh\cdot CO}_{NPh\cdot CO}>C{:}N\cdot NHPh$, forms bright yellow needles and melts and decomposes at 264°;

1 : 3-*diphenylalloxan*-p-*nitrophenylhydrazone*, 

forms well-developed orange prisms and melts at 274°; 1 : 3-*diphenylalloxanbenzyl*-p-*nitrophenylhydrazone*, 

or  , from 5-benzyl-1 : 3-diphenylbarbituric acid and diazotised *p*-nitraniline, crystallises in beautiful yellow prisms and melts and decomposes at 180°. *Alloxanphenylmethylhydrazone*,  , from alloxan and phenylmethylhydrazone, crystallises in brick-red, hexagonal plates, which melt and decompose at 189—190°.

141. "The alkylation of rhamnose." By Thomas Purdie and Charles Robert Young.

By complete methylation with silver oxide and methyl iodide, acetone- and methyl-rhamnosides yield respectively *dimethyl acetonerhamnoside* and *trimethyl methylrhamnoside*, and by hydrolysing these compounds *di*- and *tri-methylrhamnose* respectively are obtained. The rhamnose derivatives described are liquids, but, all of them excepting dimethyl rhamnose being volatile without decomposition, it was possible to isolate them by fractional distillation under reduced pressure.

Dimethyl- and trimethyl-rhamnose give crystalline phenylhydrazones, and display the ordinary properties of reducing sugars. Trimethyl rhamnose is reconverted into trimethyl methylrhamnoside by condensation with methyl alcohol and also by the silver oxide method of alkylation; the former process gives mainly the α-form of the aldoside, the latter a mixture composed largely of the β-form. The presence of the β-isomeride was recognised not only by its rotatory power, but also by the rapidity of its hydrolysis. The rotatory powers of the substances described fall into line with those of glucose and its corresponding derivatives.

142. "The alkylation of *l*-arabinose." By Thomas Purdie and Robert Evstafieff Rose.

By methylating Fischer's α-methylarabinoside with silver oxide and methyl iodide, *trimethyl α-methylarabinoside* is obtained in large, well-formed crystals (m. p. 43—45°), and by hydrolysing this with dilute

hydrochloric acid *trimethyl arabinose* is produced. This substance is a liquid (b. p. 148—152°, 19 mm.), but otherwise it exhibits the usual properties of a reducing sugar. It can be methylated by condensation with methyl alcohol, and also by treatment with methyl iodide and silver oxide, the product in both cases being a mixture of the isomeric trimethyl methylarabinosides. The condensation process yields the crystalline α-isomeride in large proportion, the silver oxide process mainly the β-isomeride. The latter substance is apparently a liquid and it could not be isolated, but its presence in the mixture was recognised by its undergoing hydrolysis more rapidly than the isomeric α-form.

In preparing Fischer's α-methylarabinoside, a small quantity of the *β-methylarabinoside* was obtained in crsytalline prisms melting at 115—117°.

With respect to rotatory power, the isomeric methylarabinosides and trimethyl methylarabinosides show relations similar to those of the corresponding derivatives of *d*-glucose.

143. "The esters of triacetic lactone and triacetic acid." By Foster Sproxton.

Ethyl triacetate, $Me\cdot CO\cdot CH_2\cdot CO\cdot CH_2\cdot CO_2Et$, is formed by heating triacetic lactone with dry alcohol in sealed tubes, and may be obtained pure by decomposing its copper salt with sulphuretted hydrogen. It gives a deep red coloration with ferric chloride.

The *ethyl* and *methyl* salts of triacetic lactone have been prepared by the action of ethyl and methyl iodides on the silver salt of the lactone. The ethyl ester could not be obtained in the pure condition. Like the analogous esters of dehydracetic acid, they have an acid reaction in aqueous solution. This property has been shown to be due, in both the triacetic lactone and dehydracetic acid derivatives, to partial hydrolysis of the esters by water. Complete hydrolysis takes place on boiling, and the parent lactone can be recovered from the solution.

144. "Optically active reduced naphthoic acids. Part II. The resolution of the tetrahydronaphthoic acids." By Robert Howson Pickard and Joseph Yates.

1 : 2 : 3 : 4-Tetrahydro-1-naphthoic acid and 1 : 2 : 3 : 4-tetrahydro-2-naphthoic acid have each been resolved into their optical antipodes by the fractional crystallisation from acetone of the *l*-menthylamine salts.

The lævo-isomeride of the first has $[M]_D$ − 28·1° in chloroform and − 92·1° in benzene, that of the second having $[M]_D$ − 91·2° in chloro-

form and $-87{\cdot}9°$ in benzene. The sodium salts when dissolved in water have respectively $[M]_D - 21{\cdot}1°$ and $-90{\cdot}5°$.

145. "The velocity of chemical change in the pentamethylen series." By N. Menschutkin, sen.

The general results of the study of the velocity of chemical change in polymethylene derivatives are as follows:

(1) The formation of the closed polymethylene chain from an open saturated chain of normal structure proceeds with increase of velocity. The maximum increase occurs in the formation of the pentamethylene ring; in the case of the hexamethylene ring the increase is less, and the heptamethylene ring is formed with the minimum increase of velocity.

(2) The increase of velocity at the closing of the open chain is not a specific property of the polymethylene ring, but is a general phenomenon observed in the formation of all closed chains, alicyclic and heterocyclic.

(3) The constants of velocity decrease according as the number of methylene groups in the polymethylene rings increases. The decrease is of the same order as is observed in the homologous series of open chain saturated carbon compounds of normal structure.

(4) The secondary polymethylene alcohols, in which the hydroxyl group is attached to the carbon atom of the ring, are typical secondary alcohols. Their esterification constants are higher than those of the saturated secondary alcohols of normal structure. Hence, the polymethylene alcohols give higher constants than all of the secondary alcohols studied. The constants of the derivatives of *cyclo*pentanol are the highest; *cyclo*hexanol gives much lower values, and *cyclo*heptanol still less.

(5) The side chain combined with the carbon atom united with the hydroxyl group gives rise to the formation of the polymethylene tertiary alcohols. Their esterification constants are very low, but esterification proceeds regularly; this is not the case with saturated tertiary alcohols, but is characteristic of phenols.

(6) When the side chains are in the ortho- and diortho-positions, a great decrease in the esterification constants is observed. This effect, commonly ascribed to the benzene ring alone, is a general property of all classes of chains whether open or closed, and containing carbon or other elements.

(7) When the side chain is in the position 3 or 4 of the polymethylene ring, an increase of esterification constants is observed, so much so that in the hexamethylene series the value of the constant of the first member of the series is exceeded.

(8) This property is not confined to the polymethylene ring, but applies generally to ringed systems, alicyclic and heterocyclic. As open chain compounds show no such increase of velocity, this is an important character of the closed chains.

(9) When a hexamethylene ring is introduced into the open chain of an alcohol, the decrease of the esterification constant is much more than is effected by the benzene ring.

(10) Hexamethylene, like hexane, exerts a very considerable retarding influence when used as a solvent in these reactions.

146. "Hydrolysis of ammonium salts by water." By Ernest George Hill.

The author aspirated a measured volume of air through solutions of different ammonium salts, the strengths of the solutions being normal, fifth-normal, and twenty-fifth-normal. The ammonia passing over was absorbed in water, or, when the amount was large, in acid. In the first case, the ammonia was estimated from the conductivity of the solution; in the latter case, by titration. It was found that for strong acids the equation $\frac{C_{\text{Acid}} \times C_{\text{Base}}}{C_{\text{Salt}}} = K$, and for weak acids

$$\frac{C_{\text{Acid}} \times C_{\text{Base}}}{C^2_{\text{Salt}}} = K$$

holds good for the concentrations of salt used.

The constants obtained in the case of the salts of mono-basic acids are inversely proportional to the molecular conductivities of the acids, and agree well with the values obtained for the strength of the acids by the various dynamical methods. In the case of dibasic acids, the constants are irregular. It is shown that the constant must depend on both the first and second ionisation-coefficients of the acids.

The author described the method employed for estimating ammonia by taking the resistance of its solution in conductivity water and comparing this with the resistance curve of ammonia. The method gave good results with solutions containing from 0·00027 to 0·009 per cent.

147. "The addition of alkyl halides to alkylated sugars and glucosides." By James Colquhoun Irvine and Agnes Marion Moodie.

When solutions of the equilibrium mixture of tetramethyl glucose in ordinary organic solvents are cooled from $+20°$ to $-20°$, the specific rotations undergo very little alteration, and, on re-heating to the initial temperature, the values originally found for the rotatory powers are exactly duplicated. When, however, an alkyl halide is used as solvent, the specific rotation at first increases slightly with fall of temperature

and then rapidly diminishes on further cooling. On re-heating the cooled solution to 20°, distinct downward multi-rotation was observed before the initial value was reached. The same regularities were shown by solutions of molecular proportions of the sugar and alkyl halides or hydrogen chloride in carbon tetrachloride.

The results point to the formation, during cooling, of oxonium compounds of the sugar with alkyl halides, and the α-form of the aldose appears to be more reactive than the β-isomeride. This was shown by a cycle of changes in specific rotation observed in the case of a solution in *iso*propyl iodide which had been cooled from 20° to 0°: (*a*) rapid decrease at 0°, due to oxonium formation; (*b*) subsequent upward multi-rotation at 0°, owing to the partial conversion, $\beta \longrightarrow \alpha$, in the uncombined sugar; (*c*) on re-heating to 20°, owing to dissociation of the oxonium compound, a rapid increase at constant temperature took place, followed by (*d*) downward multi-rotation at 20° to the initial value.

Tetramethyl α-methylglucoside also behaves abnormally when cooled in ethyl iodide solution, but the β-isomeride gives no indication of addition of the solvent. Comparable results were obtained with tetramethyl mannose and tetramethyl α-methylmannoside, but non-alkylated sugars or glucosides, when examined in mixtures of methyl alcohol and alkyl iodides, gave negative results.

The following notes have been received since the meeting:

148. "Note on the preparation of ethyl acetonedicarboxylate." By Ernest Ormerod.

In attempting to prepare ethyl acetonedicarboxylate, on fractionating the crude ester prepared by the method described by v. Pechmann (*Annalen*, 1891, **261**, 160) under reduced pressure, only a small quantity of volatile material was obtained, which on examination proved to be principally acetoacetic ester. The main product, which on cooling solidified to a white, crystalline mass, was ethylorcintricarboxylate.

Wolfman and v. Pechmann (*Ber.*, 1898, **31**, 2014) have shown that ethyl orcintricarboxylate is formed if an alcoholic solution of acetonedicarboxylic acid saturated with hydrogen chloride is allowed to stand for two or three weeks, and it was at first thought possible that the condensation had been brought about in this way during the preparation, but on examination it was found that the crude ester contained only a very small quantity of the orcinol derivative. It appeared very strange that the condensation should take place so readily, as according to Jerdan (Trans., 1899, **73**, 808) the pure ester may be heated at 180°

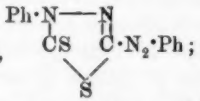
for a considerable time without any condensation taking place. Finally it was found that the condensation was brought about by the presence of a small quantity of calcium chloride which had been dissolved by the alcohol-ethereal solution of the ester. This view was shown to be correct by the fact that if the pure ester be heated with a trace of calcium chloride at 180° for a short time the amount of orcinol derivative formed corresponds to 4 per cent. of the theoretical. If the ethereal solution of the crude ester is dried over fused sodium sulphate, it may be distilled under reduced pressure without any condensation taking place.

During an attempt to prepare pure methyl acetonedicarboxylate, Dootson (Trans., 1900, **74**, 1196) obtained a crude product which, on distillation under reduced pressure, condensed very readily to form methyl orcintricarboxylate, and he came to the conclusion that the methyl ester cannot be distilled without this condensation taking place. It seems improbable that the methyl ester should differ in this respect from the ethyl ester, and, although Dootson does not state how the ethereal solution was dried, it is probable that the crude ester contained some inorganic substance which promoted the condensation.

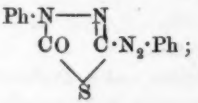
149. "The interaction of nitroformazyl, carbon bisulphide, and potassium hydroxide. A contribution to the chemistry of the thiobiazalones and the xanthates." By Ernest Ormerod.

The peculiar position of the nitro-group in nitroformazyl confers on this compound very abnormal properties: thus, by the interaction of nitroformazyl, carbon bisulphide, and potassium hydroxide, three compounds are obtained:

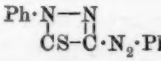
1-*Phenyl*-3-*azophenyl dithiobiazalone*,



1-*phenyl*-3-*azophenyl thiobiazalone*,



and 1-*phenyl*-3-*azophenyl*-2-*thioazethane*,



The three compounds are formed in varying quantities, depending on the solvent used and the conditions under which the experiment is carried out. Using alcohol as solvent, at the ordinary temperature the monothiobiazalone is almost exclusively formed, whilst if the interaction takes place at higher temperatures all three compounds are pro-

duced simultaneously; on using acetone or carbon bisulphide as the solvent, only the dithiobiazalone is formed.

The results obtained are interesting, as proving that a boiling alcoholic solution of carbon bisulphide and potassium hydroxide contains potassium xanthate, potassium dithiocarbonate, and potassium trithiocarbonate.

The author finds that the nitroformazyl is first reduced to formazylmercaptan, which is then acted on by the potassium xanthate, forming the dithiobiazalone, and by the potassium dithiocarbonate, forming the monothiobiazalone. The thioaziethane is apparently produced by the interaction of the potassium trithiocarbonate and the nitroformazyl.

The constitution of the biazalones obtained was proved by an examination of their decomposition products and by synthesis: the dithiobiazalone was synthesised from formazylmercaptan and thiophosgene, and the monothiobiazalone from formazylmercaptan and phosgene.

150. "Aldehydrol and the hydrates of compounds containing a carbonyl group." By William Morris Colles.

Concentrated aqueous solutions of aldehyde, acetone, formic, acetic, monochloroacetic, and trichloroacetic acids were cooled to low temperatures in an apparatus fitted with a combined filtering and stirring tube. The solutions, made up quantitatively in definite molecular proportions, were contained in a long, stoppered weighing tube into which the combined filtering and stirring tube fitted. This in turn was clamped inside a large vacuum vessel containing absolute alcohol, which, when cooled by liquid air, constituted the freezing mixture. Cooling was brought about very gradually and the solutions were very rapidly stirred. Several crystalline hydrates were obtained, the mother liquor being separated as soon as crystallisation had occurred. The following compounds of special interest were obtained: aldehydrol, $CH_3CH(OH)_2$, at $-90°$, a hydrol of formic acid, possibly *ortho*-formic acid, $HC(OH)_3$, *ortho*-acetic acid, $CH_3C(OH)_3$, and *ortho*-monochloroacetic acid, $CH_2ClC(OH)_3$. The analyses of the last two compounds, owing to experimental difficulties, were not very close. Acetone gave no result, and with trichloroacetic acid a hydrate containing 3 mols. of water was obtained. The hydrates of formic acid were fairly thoroughly investigated, and the following were obtained in a fairly pure crystalline condition: $CH_2O_2,4H_2O$, $4CH_2O_2,7H_2O$, $4CH_2O_2,3H_2O$, $3CH_2O_2.2H_2O$.

The next Ordinary Meeting will be held on **Thursday**, October **18th**, 1906, at **8.30** p.m., when the Longstaff Medal will be presented to Prof. W. N. Hartley, F.R.S.

LIST OF FELLOWS, 1906.

The List of Fellows for 1906 is now in active preparation, and changes of address received *after 31st July cannot be included in it.*

In order that the new list may be as complete as possible, those Fellows whose Degrees and Christian names do not appear in full are requested to communicate them to the Assistant Secretary.

THE LIBRARY.

The Library will be closed for Stocktaking from **Monday, August 13th,** until **Saturday, August 25th,** 1906, inclusive.

Fellows are particularly requested to return all books belonging to the Library **not later than Wednesday, August 8th.**

ERRATUM.

PROCEEDINGS, 1906, p. 94.

In the list of Fellows who have resigned:
for "H. W. Lawrence" *read* "W. T. Lawrence."

CATALOGUE

OF

ALCHEMICAL AND EARLY CHEMICAL BOOKS

PRESENTED TO THE

CHEMICAL SOCIETY

BY

SIR HENRY ENFIELD ROSCOE, D.C.L., LL.D., F.R.S.

Accum, *Fredrick*. Description of the process of manufacturing coal gas, for the lighting of streets, houses, and public buildings, with elevations, sections, and plans of the most improved sorts of apparatus now employed at the gasworks in London. Second edition. 1820. 8o. pp. xvi + 334.

Agricola, *Georg*. De re metallica libri XII. Quibus officia, instrumenta, machinæ, ac omnia denique ad metallicam spectantia, non modò luculentissimè describuntur ; sed & per effigies, suis locis insertas, adjunctis Latinis, Germanicisque appellationibus, ita ob oculos ponuntur, ut clariùs tradi non possint. Quibus àcesserunt hâc ultimâ editione, Tractatus ejusdem argumenti, ab eodem conscripti, sequentes. De animantibus subterraneis. Lib. I. De ortu & causis subterraneorum. Lib. V. De natura eorum quæ effluunt ex terra. Lib. IV. De natura fossilium. Lib. X. De veteribus & novis metallis. Lib. II. Bermannus sive de re metallica, dialogus. Lib. I. Cum indicibus diversis, quicquid in opere tractatum est, pulchrè demonstrantibus. Basileæ, Sumptibus & typis. Emanuelis König. 1657. Folio. pp. [xiv] + 708 + [xcii].

Agrippa von Nettesheym, *Heinrich Cornelius*. De incertitudine & vanitate scientiarum & artium. Apud Elorentissimam Antuerpiam. 1534. 8o. ff. 160 ; pagination irregular.

Incomplete, wanting ff. 52—53.

—— Opera, in duos tomos concinne digesta, & nunc denuò, sublatis omnibus mendis, in *φιλομούσων* gratiam accuratissimè recusa. Quibus

praeter omnes tabulas nouiter accessit ars notoria, quam suo loco interpositam reperies. Lugduni, Per Beringos Fratres. [1600.] 8vo. pp. [xxiv]+668, [xvi]+440+[xvi]. [The *Epistolarum* are separately paged.] pp. 480.

Albertus Magnus. De secretis mulierū et virorum. *Colophon.* Impressum Liptzk per Melchiorem Lotter. Anno Millesimo q'ngentesimoquinto. [1505.] 4vo. ff. [xxx].

—— De mineralibus et rebus metallicis libri quinque. Coloniæ, apud Ioannem Birckmannum et Theodorum Baumium, 1569. 12o. pp. 391+[xi].

Alchymist. Der von Mose. . . übel urtheilende Alchymist. See **Schmid,** *Johann George.*

Arnaldus de Villanova. Opera chymica: videlicet, Thesaurus Thesaurorum: seu Rosarius Philosophorum: ac omnium secretorum maximum secretum. Lumen nouum. Flos florum, & Speculum alchimiæ. Quibus nimirum artis huius mysteria etiam secretissima, luculenter enodantur, & quàm maxima licet, & potest fieri perspicuitate explicantur. Nunc primum ita coniunctim edita, opera & impensis, Hieronymi Megiseri. Francofurti, Typis Ioachimi Bratheringij. 1603. 8o. pp. 120. [The *Speculum* has a separate title-page and pagination.] pp. 80.

—— Chymische Schrifften, Darinnen begriffen. I. Der Schatz aller Schätze. II. Der philosophen Rosen-Garten. III. Das gröste Geheimnuss aller Geheimnüssen. IV. Spiegel der chymischen Kunst. Worbey zugleich mit angefüget. V. Die edle Practica der Prophetin Mariæ, Moysis Schwester. VI. Das Buch Calidis, des Sohns Jazichii, von den Geheimnüssen der Alchimie. VII. Kallid Rachaidibi, von den 3 Worten. VIII. Aristotelis Tractätlein, von der Practic des Philosophischen Steins. X. Ludus puerorum, das Kinder-Spiel und der Weiber-Arbeit. Allen Liebhabern der wahren Alchimie zu Gefallen aus dem Latein mit höchstem Fleiss in Teutscher Sprache übersetzet, Durch Johannem Hoppodamum. Franckfurt und Hamburg. In Verlegung Georg Wolffs, Buchhändlers in Hamburg, in St. Johannis Kirchen. 1683. 8o. pp. [xvi]+350.

Aureum Vellus. *See* **Trissmosin,** *Salomon.*

Balduinus, *Christianus Adolphus.* Aurum superius & inferius auræ superioris & inferioris hermeticum. Amstelodami Apud Joannem Jansonium à Waesberge. 1675. 12o. pp. [xx]+96. [Then follows the *Phosphorus hermeticus*, without pagination, pp. xiii.]

Barnaud, *Nicolas.* *See* **Ripley,** *George.*

Barth, *Jeremias.* *See* **Beguin,** *Jean.*

Batsdorff, *Heinrich von.* *See* **Reibehand,** *Christoph.*

Becher, *Johann Joachim.* Natur-Kündigung der Metallen. Mit vielen curiosen, Beweissthumben, natürlichen Gründen, Gleichnüssen,

Erfahrenheiten, und bisshero ohngemeinen Auffmerckungen vor Augen gestellet. Zur Erhaltung der Warheit, Erläuterung der Spagirischen Philosophi, und Gefallen der Liebhabern. . . . In Verlegung Johan Wilhelm Ammons und Wilhelm Serlins. Franckfurt 1661. 8o. pp. [xiv] + 347 + [xxxvii].

Becher, *Johann Joachim.* Institutiones chimicæ prodromæ i.e. . . . Oedipus chimicus obscuriorum terminorum & principiorum chimicorum, mysteria aperiens & resolvens. Opusculum, omnibus medicinæ & chimiæ studiosis, lectu perquàm utile & necessarium. Francofurti, Apud Hermannum à Sande, 1664. 12o. pp. [xiv] + 192 + [viii].

—— Chymischer Glücks-Hafen, oder grosse chymische Concordantz und Collection, von funffzehen hundert Chymischen Processen: Durch viel Mühe und Kosten auss den besten Manuscriptis und Laboratoriis in diese Ordnung, wie hier folgendes Register aussweiset, zusammen getragen. Von Johann Joachim Becher . . . und . . . Paul Flemming. Franckfurt, In Verlegung Johann Georg Schiele, Buchhändlers, 1682. 4to. pp. [viii] + 810 + [xxxv].

Bound with **Ercker**, *L.* Aula Subterranea.

—— Chymisches Laboratorium oder unter-erdische Naturkündigung. Darinnen enthalten wird: I. Die tieffe Zeugung derer unter-erdischen Dinge: Wie auch der wunderbare Bau der ober- und unter-erdischen Erd- Wasser- und Lufft-Kugel: Und dann die absonderliche Natur der unter-erdischen Dinge Aufflöss- und Zerlegung in ihre Theile, und derselben Eigenschafft. II. Neue Chymische Proben, einiger künstlichen gleich darstelligen Verwandelung derer Metallen, nach Anleitung der in vorigen Jahren in Druck gegebenen Physicæ subterraneæ. III. Ein nochmaliger Zusatz und philosophischer Beweissthum, derer Chymischen, die Wahr- und Möglichkeit, derer Metallen Verwandelung in Gold, bestreitenden Lehr-Sätze. IV. Ein chymischer Rätseldeuter, derer verdunckelten Wört-Satze Urhebung und Geheimnüsse offenbahrend und aufflösend . . . Franckfurt, zu finden bey Philipp Fievet, Buchhändl. 1690.

Incomplete, Buch I: *Physica subterranea* only, pp. [xxviii] + 732.

—— Physica subterranea profundam subterraneorum genesin, è principiis hucusque ignotis, ostendens. Opus sine pari, primum hactenus & princeps, editio novissima. Præfatione utili præmissâ, indice locupletissimo adornato, sensuumque & rerum distinctionibus, libro tersius & curatius edendo operam navavit & Specimen Beccherianum, fundamentorum, documentorum, experimentorum, subjunxit Georg. Ernestus Stahl. Lipsiæ, Apud Joh. Ludov. Gleditschium. 1703. 8o. pp. [xxx] + 1008 + [xxxvi]. [pp. 655–6 and 823–832 omitted in pagination.] The *Specimen Beccherianum* has a separate title-page and pagination. pp. [viii] + 304 + xvi.

Becher, *Johann Joachim.* Mineralisches A B C. Oder vier und zwantzig chymische Theses von der Geburt, denen Principiis, Unterschied, Vermischung, und Auflösung deren Mineralien, Metallen, und übrigen Unterirrdischen Dingen, &c. Aus dem Lateinischen ins Teutsche übersetzet. Nun aber auf vieler Begehren zum Druck befördert durch Friederich Roth-Scholtzen. Nürnberg und Altdorff, bey Johann Daniel Taubers seel. Erben, Anno 1723. 8o. pp. 150.

Beguin, *Jean.* Tyrocinium chymicum . . . à Christophoro Glückradt, et Jeremia Barthio . . . Notis elegantibus illustratum, formulisq'; medicamentorum optimis & secretis locupletatum: Nunc verò à Johanne-Georgio Pelshofero. . . . Denuo, amicorum rogatu, in publicum emissum, ac triplici Indice ornatum. Wittebergæ, Impensis Andreæ Hartmanni, Bibliopol. Typis Johannis Röhneri, Acad. Typogr. 1650. 8o. pp. [liii] + 480 + [xliv].

—— Tyrocinium chymicum, commentario illustratum. A Gerardo Blasio. Editio secunda. Amstelodami. Apud Casparum Commelinum, 1669. 8o. [xxxvi] + 332 + [viii].

Berward, *Christian. See* **Ercker,** *Lazarus.*

Berzelius, *J. Jacob.* Die Anwendung des Löthrohrs in der Chemie und Mineralogie. Zweite Auflage. Nürnberg, 1828. 8o. pp. xvi + 282.

Black, *Joseph.* Lectures on chemistry. Edinburgh. [Manuscript, written after 1760]. 4 vols. 4o. pp. 379, 436, 388, 344.

—— Vorlesungen über die Grundlehren der Chemie aus seiner Handschrift herausgegeben von Johann Robison. Aus dem Englischen übersetzt und mit Anmerkungen versehen von Lorenz von Crell. Neue wohlfeile Ausgabe. Hamburg 1818. 4 vols. 8o. pp. cvi + 444 + [viii], 548 + [xiv], 484 + [x], 284 + [vi].

Boerhaave, *Hermann.* A new method of chemistry; including the theory and practice of that art: laid down on mechanical principles, and accommodated to the uses of life. The whole making a clear and rational system of chemical philosophy. To which is prefix'd a critical history of chemistry and chemists, from the origin of the art to the present time. . . . Translated from the printed edition, collated with the best manuscript copies. By P. Shaw, and E. Chambers. With additional notes and sculptures. London: printed for J. Osborn and T. Longman, at the Ship in Pater-noster-Row 1727. 4o. pp. xvi + 384, 335.

—— Elementa Chemiae, quae anniversario labore docuit, in publicis, privatisque, scholis, Hermannus Boerhaave. Qui continet historiam et artis theoriam. Cum tabulis aeneis. Lugduni Batavorum, sumptibus Joannis Rudolphi Im-Hoff, 1732. 4o. Vol. I [xii] + 896 + [lii]: (423–4 wanting); Vol. II [vi] + 538 + [xlv].

—— Anfangsgründe der Chymie praktischer Theil, aus dem Lateinischen übersetzt. Zwote Auflage, mit Anmerkungen von Johann

Christian Wiegleb. Danzig 1791. 8o. pp. [iv] + 476 + 270 + [xlviii].

Bollinger, *Ulrich.* *See* **Croll,** *Oswald.*

Bormes. Epitre a messieurs les savans et amateurs en chymie. Pour servir de réponse à un article des Elémens d'Histoire-Naturelle et de Chymie de M. de Fourcroy; suivie de plusieurs Mémoires, sur des opérations nouvelles et curieuses en chymie. A Bruxelles 1787. 8o. pp. [iv] + 145.

Bound with **Kirwan,** *Richard.* Essai sur le phlogistique, 1788.

Borrichius, *Olaus.* De ortu, et progressu chemiæ, dissertatio. Hafniæ, typis Matthiæ Godicchenii, sumptibus Petri Haubold, Reg. Acad. Bibl. 1668. 4o. pp. [xii] + 150 + [ii].

Boyle, *Robert.* Opera varia, quorum posthac exstat catalogus. Cum indicibus necessariis & multis figuris æneis. Genevæ, apud Samuelem de Tournes 1677.

A collection of 10 tracts, each having separate title-pages, signatures, and pagination.

Cassius, *Andreas.* De extremo illo et perfectissimo naturæ opificio ac principe terrænorum sidere auro de admirandâ ejus naturâ, generatione, affectionibus, effectis, atque ad operationes artis habitudine. Cogitata nobilioribus experimentis illustrata. Hamburgi, Sumptibus Georgii Wolffi, 1685. 8o. pp. [viii] + 152.

Chambers, *C.* *See* **Boerhaave,** *Hermann.*

Charleton, *Walter.* *See* **Helmont,** *Johann Baptista van.*

Colson, *Lancelot.* Philosophia Maturata: an exact piece of philosophy, containing the practick and operative part thereof in gaining the philosophers stone; with the wayes how to make the mineral stone, and the calcination of mettals. Whereunto is added, a work compiled by St. Dunstan, concerning the philosophers stone, and the experiments of Rumelius and preparations of Angelo Sala, all most famous chymists in their time. London, Printed for G. Sawbridge, and are to be sold at his house upon Clerken-well-Green, 1668. 24o. pp. [x] + 142.

Crell, *Lorenz von.* *See* **Black,** *Joseph.*

Croll, *Oswald.* Basilica Chymica continens. Philosophicam propriâ laborum experientiâ confirmatam descriptionem et usum remediorum chymicorum selectissimorum é lumine gratiæ et naturæ desumptorum. In fine libri additus est autoris ejusdem tractatus nouus de Signaturis Rerum internis. Cum gratia et priuilegio S. Cæs. Maiest: Francofurti, Impensis Godefridi Tampachij. (*No date.*) 4o. pp. [xvi] + 283 + [xxv]; Tractatus de Signaturis, pp. [xv] + 80 + [xvi]; Elegia de Vera Antiqua Philosophica Medicina, scripta à M. Ulrico Bollingero, etc., pp. 24.

This undated edition is a re-issue of that of 1609, with a new title-page. See **Ferguson,** *John,* Bibliotheca Chemica, Vol. I., p. 185.

Croll, *Oswald.* Basilica Chymica continens. Philosophicam propriâ laborum experientiâ confirmatam descriptionem et usum remediorum chymicorum selectissimorum é lumine gratiæ et naturæ desumptorum. In fine libri additus est autoris ejusdem tractatus nouus de Signaturis Rerum internis. Cum gratia et priuilegio S. Cæs. Maiest: Francofurti, Impensis Godefridi Tampachij. (*No date.*) 4o. pp. [viii]+248+xv. Then follows: Oswaldi Crollii Von Wetter auss dem Fürstenthumb Hessen, weyland Fürstlichen Anhaltischen wolverordneten Leib Medici Tractat von den jnnerlichen Signaturen, oder Zeichen aller Dinge . . . Getruckt zu Franckfurt am Mayn, bey Caspar Rötel, in Verlegung Gottfridt Tampachs. 1629. pp. 72+7.

The title-page to the *Basilica Chymica* is identical with that of the previous work; the book, however, is a German translation. The tract on signatures has a separate title-page and pagination.

Dorn, *Gerhard.* Congeries Paracelsicæ chemiæ de transmutationibus metallorum, ex omnibus quæ de his ab ipso scripta reperire licuit hactenus. Accessit genealogia mineralium, atq; metallorum omnium, eiusdem autoris. Gerardo Dorneo interprete. Francofurti Apud Andream Wechelum, 1581. 8o. pp. 277+[i].

[Another copy.]

—— *See* **Paracelsus,** *Theophrastus.*

[**Dossie,** *Robert.*] Das geöfnete Laboratorium oder die entdeckten Geheimnisse der heutigen Chymisten und Apotheker welches viele besondere Dinge in sich enthält, die allen praktischen Aerzten zu wissen überaus nöthig sind. Aus dem Englischen übersetzt von George Heinrich Königsdörffer. Altenberg, 1760. Im Verlag der Richterischen Buchhandlung. 8o. pp. [xxxii]+324+[xii].

Englisches Klee-Blat, oder drey Elementen, Woraus Himel, Erden, Meere, mit allen ihren sichtbaren, hörbaren, fühlbaren, greiff und schmäckbaren Gestalten, bestehen. Durch fleissige Lesung Heil. Schrifft, und Englischer Bücher, Entdecket und Erwachsen. Neben denen Anweisungen Heil. Schrifft, und Meynungen der Weltweisen Ausgesetzet. Und der Königl. Preussischen Weltberühmten Societät der Wissenschafften zuförderst. Dann auch allen und jeden gelahrten und ungelahrten Liebhabern der irrdischen Wahrheiten zur ohnparthenischen, und Hochgeneigten Examinirung. Vom sichern Grund und helles Licht suchenden Authore Uberreichet. Gedruckt Anno 1709. 8o. pp. 40.

Bound with **Schmid,** *J. G.*, Der . . . Alchymist.

Erastus, *Thomas.* Disputatio de auro potabili, in qua accurate admodum disquiritur, num ex metallis, opera Chemiæ, concinnata pharmaca tutè utiliterque bibi possint. Basileæ. Apud Petrum Pernam, 1578. 8o. pp. [viii]+24+148+[xii].

Bound with **Schmid,** *J. G.*, Der . . . Alchymist.

Ercker, *Lazarus.* Aula Subterranea Domina Dominantium Subdita Subditorum. Das ist: Untererdische Hofhaltung, ohne welche weder die Herren regiren, noch die Unterthanen gehorchen können. Oder gründliche Beschreibung derjenigen Sachen, so in der Tieffe der Erden wachsen, als aller Ertzen der Königlichen und gemeinen Metallen, auch fürnehmster Mineralien, durch welche, nächst Gott, alle Künste, Ubungen und Stände der Welt gehandhabet und erhalten werden, da dann fürnemlich hierinn gelehret wird, wie sothanige Ertz- und Bergwercks-Arten, jede insonderheit ihrer Natur und Eigenschafft gemäss, auf alle Metalla probirt, und im kleinen Feuer versucht werden, nebst Erklärung einiger fürnehmer nutzlichen Schmeltzwercke im grossen Feuer, Item Ertz scheiden, puchen, waschen und rösten, auch Scheidung Goldes, Silbers, und anderer Metallen, ingleichem Kupffer saigern, Messing brennen, Salpeter sieden, destillation der Scheidwasser, und ihrem Brauch, auch zu Nutzmachung anderer mineralischen Berg- und Saltz-Arten. Anitzo aber, wegen Abgang der Exemplarien, aufs neue mit vielen nützlichen und nothwendigen Stücken und Secreten, so entweder Herr Ercker übergangen, oder nach der Zeit inventirt worden, und andern Notis über sel. Erckers Text mercklich vermehret, zusambt angehängter Auslegung der Terminorum und Red-Arten der Bergleute, Probirer, Wardeinen und Müntzmeister, deren sie sich, was ihre Profession belangt, zu bedienen pflegen. Ein sehr nützlich und nötig Werck für die Herren der Bergwercke, Berg-Rähte, Ertz- und Artzneykündiger, Probir-Discipeln, Laboranten, und alle, die mit Metallen und Mineralien umbgehen müssen oder wollen. Mit möglichstem Fleiss gestellet und ausgefertiget, durch einige hochverständige Bergwercks Erfahrne und Liebhabere. Franckfurt, In Verlegung Johann David Zunners, Buchhändlers. Druckts Johannes Haass, 1684. 4o. pp. [xiv] + 220 + 123 + [v]. [The *Interpres Phraseologiæ Metallurgicæ . . . zusammen getragen durch Christianum Berwardum* has a separate title and pagination.] 4o. pp. 68.

Bound with **Becher,** *J. J.*, Chymischer Glücks-Hafen.

Eröffnung der Thüre des Königlichen Pallasts, dass sie sey das rohe Antimonium und Materia Secunda Lapidis Philosophorum, welche vor denen mit Blindheit geschlagenen verdecket, und von denen Weisen unter doppelsinnigen Reden denen Unwürdigen verborgen gehalten worden, anjetzo aber auffs klärste durch gründliche Erweisung aller Welt wieder dargestellet wird durch einen Untersucher dieses vortreflichen Geheimnisses, der den Nahmen führet des Vorläuffers. Dressden und Leipzig, zu finden bey Gottfried Leschen, 1718. 8o. pp. [xvi] + 160.

Bound with **Hellwig,** *J. O.*, Arcana maiora.

Fabre, *Pierre Jean.* Hercules piochymicus . . . In quo penitissima, tum moralis philosophia, tum chymicæ artis arcana, laboribus Herculis, apud Antiquos tanquam velamine obscuro obruta deteguntur, & obuia fiunt et clausa omnia Philochymicis referantur. Tolosæ Tectosagum, Apud Petrum Bosc Bibliopolam, 1634. 8o. pp. [xvi] + 192.

Fanianus, *Johannes Chrysippus.* De arte metallicæ metamorphoseos liber singularis. Quo omnia, quæ ad philosophici lapidis opus pertinent, apertissimè describuntur. Item de jure artis alchemiæ veterum auctorum, & præsertim juris consultorum judicia et responsa ad quæstionem. An Alchemia sit ars legitima. Basileæ Apud Petrum Pernam, 1576. pp. [ix] + 118 (p. 24 omitted in pagination).

Bound with **Dorn,** *Gerhard,* Congeries Paracelsicæ Chemiæ.

Figuier, *Louis Guillaume.* L'Alchimie et les alchimistes, ou essai historique et critique sur la philosophie hermétique. Paris, 1854. 8o. pp. iv + 386.

Fourcroy, *Antoine-François de.* Tableaux synoptiques de chimie, pour servir de résumé aux leçons données sur cette science dans les écoles de Paris. Paris, An viii [1800]. Folio. pp. 11, and 12 double folio tables.

—— *See* **Bormes.**

Friedlibii, *Amadei.* *See* **Trium Virorum.**

Geber. Geberi des Königes der Araber, scharffsinnigen Philosophi und wahren Adepti Curieuse vollständige Chymische Schrifften, worinnen in den vier Büchern das Quecksilber, Schweffel, Arsenicum, Gold, Silber, Bley, Zinn, Kupffer, Eissen, &c., Oefen, Instrument, Sublimationen, Descension, Distillationen, Calcination, Solution, Coagulation, Fixation, Ceration, Test, Cement, Feurung, Schmeltzung, &c., ferner deren Anfänge, Præparationen, Essenzen, Saltze, Alaune, Atramente, Salpeter, Salarmoniac, Victriol, Antimonium, Bolus, Cinnober, Glass, Boras, Essig, &c., abgehandelt werden; wie auch das Testament, Güldene Buch der dreyen Wörter Kallid Rachaidibi, und andere Chymische Tractätgen, Summa, die gantze Kunst die unvollkommenen Metalle als Kupffer, Zinn, Bley, Eissen, &c., in Vollkommene, als Silber und Gold zu verwandeln, das ist: wie man Silber und Gold machen soll, enthalten, Alles aus einen Uhralten MSS. genommen, nach dem vorhandenen Exemplar in der Vaticanischen Bibliothec eingerichtet, mit gehörigen Figuren und Register versehen, und an Tag gegeben von Phileletha. Franckfurth und Leipzig, Verlegts Hieron. Philipp. Nitschel, Buchh. 1710. 8o. pp. [xvi] + 288.

Geissler, *Friedrich.* Baum des Lebens; das ist: Gründlicher Bericht vom wahrhafftigen Auro Potabili, wie ingleichen vom Wunderbahren Stein der Weisen, oder Grossen Elixir derer Philosophen &c., als der Höchsten AReZney. &c. . . . Auff Verlag Veit

Jacob Treschers, Buchändl. in Bresslau. Jena, druckts Joh. Nisius, 1683. 8o. pp. 64.

Bound with **Schmid**, *J. G.*, Der . . . Alchymist.

Girtanner, *Christoph.* Anfangsgründe der antiphlogistischen Chemie. Berlin, 1792. 8o. pp. x + 470 + [ii].

Glauber, *Johann Rudolf.* Furni novi philosophici, sive descriptio artis destillatoriæ novæ; nec non spirituum, oleorum, florum, aliorumque medicamentorum illius beneficio, facilimâ quâdam & peculiari viâ è vegetabilibus, animalibus & mineralibus, conficiendorum & quidem magno cum lucro; agens quoque de illorum usu tàm chymico quàm medico, edita & publicata in gratiam veritatis Studiosorum. Amsterodami, Prostant apud Joannem Janssonium 1651. 8o. Pars I, pp. 67 + [iii]; Pars II, pp. 148 + [iv]; Pars III, pp. 55; Pars IV, pp. 83 + [ii]; Pars V, pp. 54; Annotationes in appendicem, pp. 72.

—— De auri tinctura sive auro potabili vero. Quid sit & quommodo differat ab auro potabili falso & sophistico quomodo Spagyrice præparandum & quomodo in medicinâ usurpandum. Amsterodami, Prostant apud Joannem Janssonium 1651. 8o. pp. 22.

Bound with **Glauber**, *J. R.*, Furni novi philosophici.

—— Pharmacopœæ Spagyricæ. Pars Secunda. Amstelodami 1656. 8o. pp. 128.

—— Opera Chymica, Bücher und Schrifften, so viel deren von ihme bisshero an Tag gegeben worden. Jetzo von neuem mit Fleiss übersehen, auch mit etlichen neuen Tractaten vermehret, und umb mehrer Bequemlichkeit willen, in diese Form zusammen getragen, sampt ein darzu verfertigten vollkommenen Register. Franckfurt am Mäyn, In Verlegung Thomæ-Matthiæ Götzens. 1658. 4o. pp. [xxiv] + 574. Continuatio Operum Chymicorum . . . 1659. pp. [xii] + 444 + [xviii].

Glückradt, *Christopher.* *See* **Beguin**, *Johann.*

Hartmann, *George E.* *See* **Hartmann**, *Johann.*

Hartmann, *Johann.* Praxis Chymiatrica Johannis Hartmanni, Medicinæ Doctoris, et quondam Chymiatriæ in Academia Marpurgensi Professoris publici celeberrimi, & Principum Hassiæ Archiatri, edita â Johanne Michaelis, . . . et Georgio Euerharto Hartmanno, Authoris Filio. Lipsiæ, Sumptibus Gotofredi Grossii Bibliopolæ, 1633. 4o. pp. [xvi] + 238 (*should be* 246) + [xxx].

Heilmann, *John Jacob.* *See* **Theatrum Chemicum.**

Hellwig, *Johann Otto van.* Introitus in veram et inauditam physicam defensus per epistolam ad generosissimùm D.R.R. de St., &c., &c., à Matthia Scheffero. Francofurti, 1680. 12o. pp. 24.

Hellwig, *Johann Otto van.* Introitus in veram atque inauditam physicam. Heidelbergæ, 1680. 12o. pp. 87

Bound with **Hellwig,** *J. C. van,* Introitus . . . Francofurti, 1680.

—— Arcana maiora, oder curiöse und nützliche Beschreibung vieler wahrhaften physicalischen medicinischen, chymischen, alchymischen, chyrurgischen, und oeconomischen Geheimnisse. Aus Weltberühmter Leute, so wohl Indianischen Braminen oder Weltweisen, als auch Teutschen, Spanier, Italiäner, Engellender, Holländer, Dänen, Frantzosen, und anderer vortreflichen Männer Manuscriptis, und Correspondentzen auch eigener Erfahrung, auf seinen zwantzig jährigen weitläufftigen Reisen, mit sonderbaren Fleiss collegiret. Mit unterschiedlichen schönen raren Experimenten, Observationen, und Animadversionen vermehret. Auf ins'ändiges Verlangen vieler (so wohl Hoher als Niedriger) Patronen und Freunden, nunmehro in Druck gegeben, auch mit nützlichen Figuren und nöthigen Registern versehen. Franckfurt und Leipzig, verlegts Michael Käyser, Buchhändler in Mühlhausen, 1717. 8o. Eröfnung I, pp. [xiv]+78+[ix]; II, 93+[ix]; III, 73+[iv]; IV, 103+[ix]; V, [ii]+70+[viii]; VI, [ii]+80+[vi]; VII, ii+71+[vii] (68–69 omitted); VIII, [ii]+54 (should be 55)+[vi]; IX, [ii]+48+[vi].

Helmont, *Johann Baptista van.* A Ternary of Paradoxes. The magnetick cure of wounds, the nativity of tartar in wine, the image of God in man. Translated, illustrated, and ampliated by Walter Charleton. Londoñ, printed by James Flesher for William Lee, dwelling in Flect street, at the sign of the Turks head. 1650. 4o. pp. [lii]+144 (pagination irregular).

—— Opera omnia. Additis his de novo tractatibus aliquot posthumis ejusdem authoris, maximè curiosis pariter ac perutilissimis, antehac non in lucem editis; una cum indicibus rerum ac verborum ut locupletissimis, ita et accuratissimis, Francofurti, Sumptibus Johannis Justi Erythropili. Typis Johannis Philippi Andreæ, 1682. 4o. pp. [xl]+765+[lxxiii]. Opuscula medica inaudita. pp. [xvi]+275+[xliii].

—— *See* **Rixner,** *T. A.,* and **Siber,** *T.*

Hermbstädt, *Sigismund Friedrich. See* **Scheele,** *Carl Wilhelm.*

Hollandus, *Johann Isaac.* Sammlung unterschiedlicher bewährter chymischer Schriften, namentlich: Hand der Philosophen, Opus Saturni, Opera vegetabilia, Opus minerale, Cabala, de Lapide Philosophico, Nebst einem Tractat von den Irrgängen derer Alchymisten, Auctoris incerti, neue und verbesserte Auflage, mit gehörigem Fleise übersehen, und mit einem Verzeichnüs derer in jeglichem Tractat befindlichen wichtigsten Materien vermehret wie auch mit nöthigen Kupffern gezieret. Wien In Verlag bey Joh. Paul Krauss,

Buchhändler, 1746. 8o. pp. [xvi]+762. [pp. 129–138 omitted in pagination, and 224–225 duplicated.]

Hollandus, *Johann Isaac.* *See* **Stahl,** *Georg Ernst.*

Hoppodamus, *Johannes.* *See* **Arnaldus de Villa Nova.**

Johannes de Padua. *See* **Schaubert,** *Johann.*

Johnson, *William.* Lexicon chymicum. Cùm obscuriorum verborum, et rerum hermeticarum, tum phrasium Paracelsicarum, in scriptis ejus; et aliorum chymicorum, passim occurrentium, planam explicationem continens, Londini, Excudebat G. D. impensis Gulielmi Nealand, apud quem prostant venales sub Signo Coronæ, in vico vulgò vocato, Duck Lane, 1657. 8o. pp. [xii]+228.

Jugel, *Johann Gottfried.* Freyentdeckte Experimental-Chymie, oder Versuch den Grund natürlicher Geheimnisse durch die Anatomie und Zerlegungskunst, in dem astralischen, animalischen, vegetabilischen und mineralischen Reiche durch systematische Grundsätze, Lehrsätze, Beweise, Gegensätze, Gegenbeweise, Anmerkungen, Versuche, Erfahrungen und darauf folgende Schlüsse, nebst dem deutlichen Naturbegriffe der metallischen Generation, wie solche täglich in der Erde getrieben wird, durch eine lange Untersuchung, also vorzustellen, dass es ein jeder Naturforschender einsehen und erkennen kann; In zwey Theile abgefasset, und zu jedermanns Nutzen und Vergnügen dem Drucke überlassen. Leipzig, verglegts Johann Paul Krausse, Buchhändler, 1766. 8o. pp. [xiv]+368. [pp. 209–214 are not numbered.]

Karsten, *Wenceslaus Johann Gustav.* Physisch-chymische Abhandlungen durch neuere Schriften von hermetischen Arbeiten und andre neuere Untersuchungen veranlasset. Halle im Magdeburgschen in der Rengerschen Buchhandlung, 1786. 8o. Heft I, pp. 208; Heft II, [iv]+154.

Keiling, *George.* *See* **Trium Virorum.**

Kelley, *Edward.* Tractatus duo egregii, de lapide philosophorum, una cum theatro astronomiæ terrestri, cum figuris, in gratiam filiorum hermetis nunc primum in lucem editi, curante J. L. M. C. Hamburgi. Apud Gothofredum Schultzen. Anno 1676. 8o. pp. 125.

Khunrath, *Heinrich.* Amphitheatrum Sapientiæ Æternæ Solius Veræ, Christiano-Kabalisticum, Divino-Magicum, nec non Physico-Chymicum, Tertriunum, Catholicon: instructore Henrico Khunrath Lips: Theosophiæ amatore fideli, et Medicinæ utriusq; Doct: Hallelu-Iah! Hallelu-Iah! Hallelu-Iah Phy diabolo! E Millibus Vix Vni. Anno M.D.C.II. Cum Privilegio Cæsareæ Majest: ad Decennium A Prima Impressionis Die. *Colophon:* Hanoviæ Excudebat Guilielmus Antonius, MDCIX. Folio. pp. [iv]+60+222+[i], [10 engraved symbolic plates, not included in the pagination].

Kircher, *Athanasius.* Ars magna lucis et umbræ, in X. libros digesta. Quibus admirandæ lucis & umbræ in mundo, atque adeò universa natura, vires effectusque uti nova, ita varia novorum reconditiorumque speciminum exhibitione, ad varios mortalium usus, panduntur. Editio altera priori multò auctior . . . Amstelodami, Apud Joannem Janssonium à Waesberge, & Hæredes Elizæi Weyerstraet, 1671. Folio. pp. [xxxii]+810 (should be 710, pp. 424–525 having been omitted in pagination) +[ix].

—— Mundus Subterraneus, in XII libros digestus; quo divinum subterrestris mundi opificium, mira ergasteriorum naturæ in eo distributio, verbo *παντάμορφον* protei regnum, universæ denique naturæ majestas & divitiæ summa rerum varietate exponuntur. Abditorum effectuum causæ acri indagine inquisitæ demonstrantur, cognitæ per artis & naturæ conjugium ad humanæ vitæ necessarium usum vario experimentorum apparatu, necnon novo modo & ratione applicantur. Editio tertia, ad fidem scripti exemplaris recognita, & prioribus emendatior: tum ab Auctore Româ submissis variis observationibus novisque figuris auctior. Amstelodami, Apud Joannem Janssonium à Waesberge & Filios, 1678. Folio. pp. [xviii]+366+[vi]. [x]+507+[ix].

Kirwan, *Richard.* Essai sur le phlogistique, et sur la constitution des acides, traduit de l'anglois de M. Kirwan; avec des notes de MM. de Morveau, Lavoisier, de la Place, Monge, Berthollet, et de Fourcroy. A Paris, 1788. 8o. pp. xii+344+[iv].

Kleyn Distillierbüch. Ein newer und leichter Underricht, Künstliche Distillier öfen zumachen, alle Kreutter zubrennen, und warzü ein iedes Distilliert wasser güt zunützen. Franckfurt Chri. Ege. *Colophon:* Zu Strassburg bei Christian Egenolphen, Im Augst, Des M.D. und XXX. Jars. 4o. ff [iv]+xxvi.

Kunckel, *Johann.* Chymische Anmerckungen: darinn gehandelt wird von denen principiis Chymicis, Salibus Acidis und Alkalibus, Fixis und Volatilibus, in denen dreyen Regnis, Minerali, Vegetabili und Animali; wie auch vom Geruch und Farben, &c. Mit Anhang einer chymischen Brille contra Non-Entia Chym. Nach eigener Experientz beschrieben, mit unterschiedenen Experimentis bewähret, und denen Warheit- und Kunst-Liebenden zu Nutz und Dienstlichen Gefallen in den Druck befördert. Wittenberg, In Verlegung Job Wilhelm Fincelii seel. Erben, Druckts Christian Schrödter, 1677. 8o. pp. [xiv+192].

—— V. Curiose Chymische Tractätlein; als: I. Chymische Anmerckungen, darinn gehandelt wird von denen Princip. Chym. Sal. Acid. & Alcalibus; Fixis & Volatilib. in denen 3 Regnis; wie auch vom Geruch und Farben &c. mit Anhang einer Chymischen Brille, contra Non-Entia Chym. II. Nützliche Observa-

tiones von den Fixen und flüchtigen Saltzen, Auro & Argento Potabili; Spiritu Mundi u. d. g. wie auch von den Farben und Geruch der Metallen, Mineral. &c. III. Epistola, contra Spiritum Vini sine Acido. IV. De Phosphoro Mirabili; dessen leuchtenden Wunder-Pilulen; sampt einem Discurs vom Nitro. V. Probier-Stein, de Acido & Urinoso, Sale Calido & Frigido; contra Herrn D. Voigts Spir. Vini Vindicatum. Wobey zugleich angehänget wird: Christoph Brummets Tractätlein vom Blut der Natur. Nebst einer Vorrede . . . D. Johannis Philippi Burggravii. Franckfurth und Leipzig, 1721. 8o. pp. [xii] + 512 + [xlviii].

[Another copy.]

Kunckel, *Johann.* Ars Vitraria Experimentalis, oder vollkommene Glasmacher-Kunst, lehrende, als in einem, aus unbetrüglicher Erfahrung, herfliessendem Commentario, über die von dergleichen Arbeit beschriebene sieben Bücher P. Anthonii Neri, von Florenz, und denen darüber gethanen gelehrten Anmerckungen Christophori Meretti . . . (so aus den Italien und Lateinischen beyde mit Fleiss ins Hochteutsche übersetzt) . . . Samt einem II Haupt-Theil . . . Alles hin und wieder in dieser dritten Edition um ein merckliches vermehret. Nürnberg, 1743. 4o. pp. [xii] + 472 + [xx].

—— *See* **Neri,** *Antonio.*

Kunst- und Werck-Schul. Wieder Neu aufgerichtete und vergrösserte in Zwey Theilen angewiesene curieuse Kunst- und Werck-Schul, deren Erster Theil meistens alterley Erdenckliche, nutzlich- und bewehrte Feuer-Künste vorstellet: Als I. Die wahre Erkäntnus der Ertzen und Metallen . . . II. Die schöne Form-Kunst, Bereitung guter Feuer-beständiger Haffner-Geschirr, als Oefen, Tiegel, etc. . . . III. All erhand schöne Glas-Künste, wie man schönes Crystallen . . . IV. Von denen natürlichen Edelgesteinen . . . V. Allerley schöne ungemeine Chymische Secreta und Medicinalia . . . Ein Werck so allen Kunstliebenden dienlich und nutzlich, mit grosser Müh und Fleiss zusammengetragen selbst sehr viel davon experimentirt, und endlichen aus Christlicher Liebe mit getheilet und am Tage gegeben durch J. K. sonderbaren Liebhaber der Edlen Chymiæ und anderer natürliche Kunst- und Wissenschafften. Nürnberg, in Verlegung Johann Ziegers, Buchhändlern, 1705. 4o. pp. [vi] + 1357 + [lvii].

Le Febure [*Nicolas*]. A compleat body of chymistry: teaching the whole practice thereof by the most exact preparation of animals, vegetables and minerals, preserving their essential vertues. By Nicasius le Febure. . . . Rendered into English by P. D. C. London, printed by Tho. Ratcliffe for Octavian Pulleyn Junior, and are to be sold at the sign of the Bible in St. Pauls Church-yard near the

little North-door, 1664. 4o. Part I, pp. viii + 312 + [vii]; Part II pp. [ii] + 364 + [viii].

The title-page to part I is missing, the above title-page being that of part II.

Lemery, *Nicolas.* Cours de chymie, contenant la manière de faire les opérations qui sont en usage dans la médecine, par une méthode facile. Avec des raisonnements sur chaque opération, pour l'instruction de ceux qui veulent s'appliquer à cette science. Troisieme edition. Paris, 1679. 8o. pp. [xxx] + 659 + [xv].

—— A course of chymistry, containing an easie method of preparing those chymical medicins which are used in physick. With curious remarks and useful discourses upon each preparation, for the benefit of such as desire to be instructed in the knowledge of this art. The third edition, translated from the eighth edition in the French, which is very much enlarged beyond any of the former. London, printed by R. N. for Walter Kettilby, at the Bishop's Head in S. Paul's Church-yard, 1698. 8o. pp. [xxviii] + 815 + [xvi].

[Lenglet Dufresnoy, *Nicolas.*] Histoire de la philosophie hermetique. Accompagnée d'un Catalogue raisonné des écrivains de cette science. Avec le véritable Philalethe, revû sur les originaux. Paris 1742. 3 vols., 12o. pp. xxiii + 486 + xx; xxxii + 120 + 360; [xxii] + 432.

Lewinstein, *Gustav.* Die Alchemie und die Alchemisten. (Sammlung gemeinverständlicher wissenschaftlicher Vorträge, herausgegeben von Rud. Virchow und Fr. v. Holtzendorff. V. Serie, Heft 113.) Berlin, 1870. 8vo. pp. 36.

Libavius, *Andreas.* Alchymia Andreæ Libavii, recognita, emendata, et aucta, tum dogmatibus & experimentis nonnullis; tum commentario medico physico chymico: qui exornatus est variis instrumentorum chymicorum picturis; partim aliunde translatis, partim planè nouis: In gratiam eorum, qui arcanorum naturalium cupidi, ea absq; inuolucris elementarium & ænigmaticarum sordium, intueri gaudent. Francofurti, Excudebat Joannes Saurius, impensis Petri Kopffi. 1606. Folio. pp. [xx] + 196 + xii. Commentariorum . . . Pars Prima. pp. [x] + 402. Pars Secunda. pp. 192 + [x].

—— Syntagmatis selectorum undiquaque et perspicue traditorum Alchymiæ Arcanorum, Tomus primus. In quem congesta sunt commentaria Chymiæ hactenus desiderata: Insertis passim scholijs, & commentationibus ipsis, ad penitissima huius philosophiæ & medicinæ ducentibus. Conscriptus et in IIX libros digestus. Francofurti Excudebat Nicolaus Hoffmannus, Impensis Petri Kopffii, 1615. Folio. pp. [xi] + 480 + [vii] . . . Tomus Secundus. In quem congesta sunt partim noua, eaq; penitiora Spagyrorum secreta, partim prioris tomi nonnulla explicatius tradita, & inter ea etiam ænigmatica Quercetani,

aliorumque Hermeticorum non pauca studiosè inuestigata, declarata & iudicata. . . . . Cum Indice copioso duplici, Chymico & Medico. Francofurti . . . 1613. pp. [xii] + 453 + [xiv].

Lullius, *Raymundus.* Illuminati sacre pagine pfessoris amplissimi magistri Raymundi Lull. ars magna, generalis et ultima: quarūcunq; artium ⁊ scientiarum ipsius Lull. assecutrix et clauigera: ⁊ ad eas aditum faciliorē prebēs: antehac nusq; arti impressorie emūcrius cōmendata: ⁊ per magistrum Bernardum la Vinheta artis illius fidelissimū interpretē elimata. Una cum figuris suo situ decenter intextis ⁊ totius operis enucleatiuis. Incertis preterea cuilibet parti, capitulo et rubrice, titulis et annotationibus: adiecto indice alphabetico siue repertorio, sententias electiores cōplectente: ad folia remissiuo. *Colophon* . . . . Lugduni per Jacobum Marechal calcographum: sumptibus vero Simonis Vincent . . . 1517. 8o. ff. [iv] + 124.

—— Testamentum, duobus libris universam artem chymicam complectens antehac nunquam excusum. Item eiusdem compendium animæ transmutationis artis metallorum, absolutum iam & perfectum. Coloniæ Agrippinæ, Apud Ioannem Byrckmannum, 1566. 8o. ff. [iv] + 240 + [viii] (wanting f. 24).

—— Codicillus seu vade mecum. Coloniæ 1572. 8o. pp. 248.

—— Libelli aliquot chemici: [Testamentum novissimum; Elucidatio vocabulorum; Vade mecum; Compendium de transmutatione animæ metallorum; De compositione gemmarum; Epistola accurtatoria ad regem Neapolitanum; Medicina magna; Dialogus Demogorgon.] Basileæ, Apud Petrum Pernam, 1572. 8o. pp. [xvi] + 480 + [xxxi].

—— Libelli aliquot chemici. Basileæ, Typis Conradi Waldkirchii, 1600. 8o. pp. [xii] + 393 + [xxvi].

—— Aureumsane opus, in quo ea omnia breviter explicantur, quæ scientiarum omnium Parens, tam in scientiarum Arbore, q̄ arte generali tradit. Autore Valerio de Valeriis Patricio Veneto, & scientiarum amatore, 1589. Augustæ vindelicorum imprimebat Michaël Manger. 4o. pp. [viii] + 179.

Manget, *Jean Jacques.* Bibliotheca chemica curiosa, seu rerum ad alchemiam pertinentium thesaurus instructissimus: quo non tantùm artis auriferæ, ac scriptorum in ea nobiliorum historia traditur; lapidis veritas argumentis & experimentis innumeris, immò & juris consultorum judiciis evincitur; termini obscuriores explicantur; cautiones contra impostores, & difficultates in tinctura universali conficienda occurrentes, declarantur: Verùm etiam tractatus omnes virorum celebriorum, qui in magno sudarunt elixyre, quique ab ipso Hermete, ut dicitur, Trismegisto, ad nostra usque tempora de chrysopoea scripserunt, cum præcipuis suis commentariis, concinno ordine dispositi exhibentur. Ad quorum omnium illustrationem additæ sunt quamplurimæ figuræ

æneæ. Coloniæ Allobrogum, Sumpt. Chouet, G. De Tournes, Cramer, Perachon, Ritter, & S. De Tournes. 1702. 2 vols., folio. pp. [xx]+938, [ii]+904.

A full list of the contents of this work is given in **Bolton**, *H. C.*, Bibliography of Chemistry, pp. 1005–1013, and **Ferguson**, *J.*, Bibliotheca Chemica, Vol. II, pp. 68–70.

Merrett, *Christopher*. *See* **Kunckel**, *Johann*.

—— *See* **Neri**, *Antonio*.

Meurdrac, *Maria*. Die Mitleidende und leichte Chymie dem löblichen Frauen-Zimmer zu sonderbahrem Gefallen in Frantzösischer Sprach beschrieben durch Jungfr. Maria Meurdrac, und nunmehr in Teutsch übersetzt und heraussgegeben von J. L. M. C. Sampt einem Tractätlein, wie man allerhand wohlriechende Sachen künstlich præpariren sol, durch Johann Muffatz. Franckfurt, In Verlegung Joh. David Zunners, 1673. 12mo. pp. [viii]+411+[xxv].

Michaelis, *Johann*. *See* **Hartmann**, *Johann*.

Musæum Hermeticum Reformatum et Amplificatum, omnes sophospagyricae artis discipulos fidelissime erudiens, quo pacto summa illa veraque Lapidis Philosophici Medicina, qua res omnes qualemcunque defectum patientes, instaurantur, inveniri et haberi queat. Continens Tractatus Chimicos XXI. præstantissimos, quorum nomina et seriem versa pagella indicabit. In gratiam filiorum doctrinae, quibus Germanicum idioma ignotum est, Latina lingua ornatum. Francofurti et Lipsiae, 1749. 4o. pp. [xii]+862+[i].

A list of the contents of this work is given in **Ferguson**, *J.*, Bibliotheca Chemica, Vol. II, p. 119.

Neri, *Antonio*, **Merrett**, *Christopher*, and **Kunckel**, *Johann*. Art de la verrerie, de Neri, Merrett et Kunckel. Auquel on a ajouté le Sol sine veste D'Orschall; l'helioscopium videndi sine veste solem chymicum; le Sol non sine veste; le chapitre XI. du Flora Saturnizans de Henckel, sur la vitrification des végétaux; un mémoire sur la maniere de faire le saffre; le secret des vraies porcelaines de la Chine & de Saxe . . . Traduits de l'Allemand, par M. D * * * Paris 1752. 4o. pp. [iv]+lv+630+[ii].

Paracelsus, *Theophrastus*. Dess hocherfahrnesten Medici Aureoli Theophrasti Paracelsi schreyben, von den kranckheyten, so die vernunfft berauben, als da sein S. Veyts Thantz, Hinfallender siechtage, Melancholia vnd Vnsinnigkeit, &c., sampt ihrn warhafften curen. Darzu auss gemeldts Authoris Büchern gethan sein etliche lustige und nutzbare Process, Administrationes und würckungen dess Vitriols und Erdenhartzes, in rechter treuw publiciert, durch Adamum von Bodenstein . . . Innhalt und frucht dieses Buchs wird in der ersten Vorrede ordenlich begriffen. (Basilee) 1567. 4o. ff. [58]. [Sig. *, A—O_2; g.l. missing.]

Paracelsus, *Theophrastus.* Aurora Thesaurusque Philosophorum, Theophrasti Paracelsi, Germani Philosophi, & Medici præ cunctis omnibus accuratissimi. Accessit Monarchia Physica per Gerardum Dorneum, in defensionem Paracelsicorum Principiorum, à suo Præceptore positorum. Præterea Anatomia uiua Paracelsi, qua docet autor præter sectionem corporum, & ante mortem, patientibus esse succurrendum. 1577. Basilae. 8o. pp. 63.

Bound with **Dorn**, *Gerhard*, Congeries Paracelsicæ, &c., 1581.

—— Aureoli Theophrasti Paracelsi de summis naturæ mysteriis commentarij tres, à Gerardo Dorn conuersi, multóque quàm antea fideliter characterismis & marginalibus exornati, auctíque. Quorum nomina sequens pagella dabit. Basileæ, Ex Officina Pernæa per Conr. Vvaldkirch, 1584. 8o. pp. [xvi]+173 [should be 149]+x [pagination irregular].

—— Opera omnia medico-chemico-chirurgica, tribus voluminibus comprehensa. Editio novissima et emendatissima, ad Germanica & Latina exemplaria accuratissimè collata: Variis tractatibus & opusculis summâ hinc inde diligentiâ conquisitis, vt in voluminis primi præfatione indicatur, locupletata: Indicibusq́; exactissimis instructa. Genevæ, Sumptibus Ioan. Antonij, & Samuelis De Tournes. MDCLIIX. Vol. I, pp. [xxxiv]+828+[xxxix]; Vol II, [xxii]+718+[xxxii]; Vol. III, [xii]+212+[xxvii]; Vol. III, Sect. II, [iv]+119+[vii]. Testamentum, Dictionariolum, &c., 18.

—— Chymischer Psalter, oder Philosophische Grundsätze vom Stein der Weisen Anno 1522. Aus dem höchst seltenen lateinischen Grundtext übersetzt, von einem Liebhaber natürlicher Geheimnisse. Amsterdam, 1771. 8o. pp. [xvi]+32.

—— *See* **Dorn**, *Gerhard.*

—— *See* **Thurneisser**, *Leonhart.*

—— *See* **Trissmosin**, *Salomon.*

Porta, *Giovanni Baptista.* Magiæ Naturalis libri viginti. Ab ipso quidem authore ante biennium adaucti, nunc verò ab infinitis, quibus editio illa scatebat mendis, optimè repurgati: in quibus scientiarum naturalium diuitæ & deliciæ demonstrantur. Accessit index, rem omnem dilucidè repræsentans copiosissimus. Librorum ordinem, qui in hoc opere continentur, versa pagina indicabit. Francofurti apud Andræ Wecheli heredes, Claudium Marnium, & Ioann. Aubrium. 1591. 8o. pp. [xxxvi]+669.

—— La magie naturelle: qui est, les secrets & miracles de Nature, mise en quatre livres, par Iean Baptiste Porta Neapolitain. Nouvellement traduite de Latin François. Rouen 1606. 8o. ff. [vii]+278+[xvii].

—— Magia naturalis, oder Haus-Kunst- und Wunder-Buch. Zu erst von dem selben Lateinisch beschrieben; hernach von Ihm selbst

vermehret; nunmehr aber allen Liebhabern der natürlichen Wissenschafften zum besten, nicht nach dem alten Druck, der Frantzösischen und Teutschen Edition, darinnen nur vier Bücher; sondern durch alle zwantzig Bücher gantz aufs neu in die Hochteutsche Sprache übersetzet; von allen Fehlern, so in dem Lateinischen Druck, mit grossem Hauffen übrig geblieben, und aufs neue eingeschlichen, aufs fleissigste gereiniget; in gewisse mit Zahlen unterschiedene Absätze abgetheilet; mit deutlichen Teutschen Kunst-reimen gezieret; an Figuren gebessert, mit schönen Kupfern geschmücket; mit nothwendigen Anmerckungen und Auflösungen der darinn enthaltenen Rätzel, wie auch vielen neuen ungemeinen guten Chymischen und andern Stücken vermehret, auch mit guten Registern versehen, und in zweyen Theilen, deren das erste, die ersten sieben; das andre die letzten dreyzehen Bücher in sich enthält, heraus gegeben durch Christian Peganium, sonst Rautner genannt. Nürnberg, in Verlegung Johann Ziegers Buchhändlers. Gedruckt zu Sultzbach durch Abraham Liechtenthaler, 1680. Erste Buch. 8o. pp. [x]+990+[cxiv] [pp. 1–2 and 15–16 missing; the latter are supplied in manuscript]. Zweite Buch. pp. [i]+876+[xxxvi] [pp. 847–848 omitted in pagination].

Rebentrost, *David.* *See* **Trium Virorum.**

[Reibehand, *Christoph.*] Filum Ariadnes das ist: Neuer chymischer Discurs von den grausamen und verführischen Irrwegen der Alchymisten, dadurch sie selbst und viel Leute neben ihnen verleitet werden, und dann, was doch endlich der rechte uhralte einige Weg zu dem allerhöchsten Secreto sey, wie darinnen zu procediren, und welcher gestalt auch particularia zur Hand gebracht werden können. Alles durch selbst-eigene Experientz erkläret und an Tag gegeben durch Heinr. von Batsdorff, Hermundurum. Denen sind noch beygefüget LXXIX. grosse und sonderbahre Wunder. So bey einem Special angegebenen Subjecto theils von der Natur, theils aber in der geführten Arbeit sich befunden haben. Gotha, Verlegts Jacob Mevius, 1718. 8o. pp. [xvi]+136. [The *Grosse und sonderbahre Wunder* . . . 1725, has a separate title-page and pagination.] pp. 71.

Bound with **Valentinus,** *B.*, Chymische Schriften, 1740.

Ripley, *George.* Chymische Schrifften des hochgelehrten, fürtrefflichen und weitberhümten Philosophi Georgii Riplæi, Canonici Angli. Darinnen vom gebenedeyeten Stein der Weisen und desselben kunstreicher præparation gründlich gelehret wird, Zuvor durch den Hochgelahrten Herrn Nicolaum Barnaudum Chymicum zu Lateinischer Sprache publiciret, Jetzo aber allen Filiis doctrinæ zum besten durch einen Liebhaber der Kunst in Deutsche Sprache gebracht, und in Druck gegeben Anno 1624. Gedruckt In verlegung Johann

Birckners, Buchhändlers in Erffurt. 8o. pp. [i]+113 [should be 111, pagination irregular].

Rixner, *Thaddä Anselm,* **and Siber,** *Thaddä.* Leben und Lehrmeinungen berühmter Physiker am Ende des XVI und am Anfange des XVII Jahrhunderts, als Beyträge zur Geschichte der Physiologie in enigerer und weiterer Bedeutung. Heft VII. Joh. Bapt. v. Helmont. Sulzbach, 1826. 8o. pp. viii+245+[iii].

Robison, *Johann. See* **Black,** *Joseph.*

Rosencreutz, *Christian.* Chymische Hochzeit: Christiani Rosencreütz. Anno 1459. Arcana publicata vilescunt; & gratiam prophanata amittunt. Ergo: ne Margaritas obijce porcis, seu Asino substerne rosas. Strassburg, In Verlägung, Lazari Zetzners. 1616. *Colophon*: Strassburg, Gedruckt bey Conrad Scher, Im Jahr MDCXVI. 8o. pp. 146+[ii].

Roth-Scholtz, *Friederich.* Deutsches Theatrum Chemicum, auf welchem der berühmtesten Philosophen und Alchymisten Schrifften, die von dem Stein der Weisen, von Verwandlung der schlechten Metalle in bessere, von Kräutern, von Thieren, von Gesund- und Sauer-Brunnen, von warmen Bädern, von herrlichen Artzneyen und von andern grossen Geheimnüssen der Natur handeln, welche bisshero entweder niemahls gedruckt, oder doch sonsten sehr rar worden sind. Nürnberg, bey Adam Jonathan Felsseckern 1728–1732. 3 vols., 8o. [ii]+26+[ii]+680+32+350; 22+935; 46+960.

A full list of the contents of this work is given in **Bolton,** *H. C.*, Bibliography of Chemistry, pp. 1035–1040, and **Ferguson,** *J.*, Bibliotheca Chemica, Vol. II, pp. 298–299.

—— Bibliotheca Chemica. H. E. Collectio Auctorum fere omnium, qui de naturae arcanis, re metallica et minerali, item de melioratione corporum artificiali etc., Hermetice scripserunt. Recensentur etiam diversae librorum editiones aliaque huius generis manuscripta hactenus inedita. Fasciculus primus editio secunda. Norimbergae et Altdorfii apud Haeredes Joh. Dan. Tauberi. 1735. 8o. pp. 238.

—— *See* **Becher,** *Johann Joachim.*

[**Schaubert,** *Johann.*] Auszug aus des Joannis von Padua consumata Sapientia oder Praxis von dem Mineralischen Stein. Franckfurt Anno 1681 in Duodez. Item daselbst aus d. Epistl Joannis Trithemii, item daselbst aus d. Epistl Joannis Teutz Schescheni, etc. [Manuscript.] 8o. pp. [ii]+126.

The above consists of manuscript extracts from **Schaubert,** *Johann* Consummata Sapientia, seu Philosophia Sacra, Praxis der Lapide Minerali, Johannis de Padua, Epistola Johannis Trithemii, Von den dreyen Anfängen aller natürlichen Kunst der Philosophiæ. Epistola Johann Teutzscheschcni, De Lapide Philosophorum . . . Francofurti, 1681. 12o. pp. 282.

Scheele, *Carl Wilhelm.* Sämmtliche physische und chemische Werke, nach dem Tode des Verfassers gesammlet, und in deutscher Sprache herausgegeben von Sigismund Friedrich Hermbstädt. Berlin, 1793. 2 vols., 8o. pp. xxxii + 264, 446.

[**Schmid,** *Johann Georg.*] Der von Mose u. denen Propheten übel urtheilende Alchymist, wird fürgestellet in einer Schrifft-gemässen Erweisung, dass Moses und einige Propheten, wie auch David, Salomon, Hiob, Esra und dergleichen, keine Adepti Lapidis Philosophorum gewesen sind; Ingleichen dass die Lehre und alchymistisch Vorgeben, von Verwandlung der geringen Metalle in Gold, eine lautere Phantasie und schädliche Einbildung sey; Von einem Liebhaber der Wahrheit, der sich tröstet, dass der Allmächtige sein Gold sey, Hiob XX. v. 25. und nichts Jm Golde Sucht. Chemnitz, bey Conrad Stösseln, 1706. 8o. pp. [xiv] + 144.

Shaw, *Peter. See* **Boerhaave,** *Hermann.*

Siber, *Thaddä. See* **Rixner,** *Thaddä Anselm.*

Stahl, *Georg Ernst.* Zufällige Gedancken und nützliche Bedencken über den Streit, von dem so genannten Sulphure, und zwar sowol dem gemeinen, verbrennlichen, oder flüchtigen, als unverbrennlichen, oder fixen. Halle, In Verlegung des Wäysenhauses, 1718. 8o. pp. [viii] + 373.

—— Zymotechnia fundamentalis, oder allgemeine Grund-Erkänntniss der Gährungs-Kunst, vermittelst welcher die Ursachen und Würckungen dieser alleredelsten Kunst, welche den nutzbahrsten und subtilesten Theil der gantzen Chymie ausmacht. Aus den wesentlichen mechanisch-physischen Haupt-Gründen überhaupt mit höchstem Fleiss ans Licht gestellet, und mit einem neuen chymischen Experiment, wie ein wahrer Schwefel durch Kunst zum Vorschein zu bringen; wie auch mit andern nützlichen Erfahrungs-Proben und Anmerckungen dem Publico mitgetheilet werden. Wegen ihres unbeschreiblichen Nutzens aus dem Lateinischen ins Teutsche übersetzet. Franckfurth und Leipzig. Verlegts Johann Leopold Montag [in Regenspurg, 1734]. [Title-page cut down.] 8o. pp. [xxii] + 304.

—— Fundamenta chymiae dogmaticae et experimentalis, et quidem tum communioris physicae mechanicae pharmaceuticae ac medicae tum sublimioris sic dictae hermeticae atque alchymicae. Olim in privatos auditorum usus posita, jam vero indultu autoris publicae luci exposita. Annexus est ad coronidis confirmationem tractatus Isaaci Hollandi De Salibus et Oleis Metallorum. Editio secunda, emendatior et auctior. Norimbergae, impensis B. Guolfg. Maur. Endteri Consortii et Vid. B. Iul. Arnold Engelbrechti. 1746–7. 3 vols., 4o. pp. [viii] + 255 + [xxiii], [viii] + 76 + 199 + [31], [viii] + 508 + [xviii].

—— *See* **Becher,** *Johann Joachim.*

Sternhals, *Johann.* Ritter-Krieg das ist: Ein Philosophisch-Ge-

schicht, in Form eines gerichtlichen Processes, wie zwey Metallen, nemblich Sol und Mars, durch Klag, Antwort und Beweiss, jegliches Natur uñ Eigenschaft von ihrem nätürlichen Gott und Richter ☿rio gehöret, und endlich durch ein wol-gegründetes Urtheil, mit ewig-wahrender Freundschafft einig zusammen verbunden werden. Länger denn vor 200. Jahren durch den Ehr-Würdigen Herrn Johann Sternhals, damahls Catholischen Priester des Bischöfflichen Stiffts Bamberg, als einem wahren Chymico und Philosopho laut seiner eigenen Vorrede gestellet. Jtzo wieder auffs neu ubersehen und zum Druck heraussgegeben. Hamburg, In Verlegung George Wolff, Buchhändl. in S. Johañes-Kirchen, 1680. 8o. pp. [xii]+96.

Bound with **Suchten,** *Alexander von,* Chymische Schrifften.

Suchten, *Alexander von.* Chymische Schrifften alle, so viel deren vorhanden, zum ersten mahl zusammen gedruckt, mit sonderbahrem Fleiss von vielen Druckfehlern gesäubert, vermehret, und in zwey Theile, als die Teutschen Lateinischen verfasset. Franckfurt am Mayn, In Verlegung Georg Wolffs, Buchh. in Hamburg, Druckts Johann Görlin. 1680. 8o. pp. [xiv]+486+[ix].

Teutzscheschen, *Johann. See* **Schaubert,** *Johann.*

Theatrum Chemicum, præcipuos selectorum auctorum tractatus de chemiæ et lapidis philosophici antiquitate, veritate, jure, præstantia, & operationibus, continens: In gratiam veræ chemiæ, & medicinæ chemicæ studiosorum (ut qui uberrimam inde optimorum remediorum messem facere poterunt) congestum, & in sex partes seu volumina digestum; Singulis voluminibus, suo auctorum et librorum catalogo primis pagellis: rerum verò & verborum indice postremis annexo. Argentorati, sumptibus Heredum Eberh. Zetzneri 1659–61. 6 vols., 8o. Vol. I, pp. 794+[xxx]; Vol. II, 549+[vii]; Vol. III, 859+[xiii]; Vol. IV, [viii]+1014+[xxxiii]; Vol. V, [viii]+912+[xxix]. *Vol. VI has the following title:* Theatri Chemici volumen sextum, theologis, medicis, et tam vulgaribus quam hermeticæ, chemiæ studiosis utilissimum, præcipuos selectorum auctorum huius seculi tractatus de chemia & lapidis philosophici antiquitate, veritate jure præstantia & operationibus continens, ex Germanica & Gallica lingua in Latinam translatum per Johannem Jacobum Heilmannum, Argentorati, sumptib. Hæredum Eberhardi Zetzneri, 1661. pp. [xviii]+772+[xxv].

A full list of the contents of this work is given in **Bolton,** *H. C.,* Bibliography of Chemistry, pp. 1050–1058, and **Ferguson,** *J.,* Bibliotheca Chemica, Vol. II, pp. 436–439.

Thomson, *Thomas.* A system of chemistry. In four volumes. The second edition. Edinburgh. 1804. 8o. pp. xvi+605, viii+596, vii+629, viii+808.

—— An attempt to establish the first principles of chemistry by

experiment. In two volumes. London 1825. 8o. pp. xxiii + 478, vii + 532.

Thomson, *Thomas.* A system of chemistry of inorganic bodies. In two volumes. Seventh edition. London and Edinburgh, 1831. 8o. pp. ix + 944, viii + 742.

Thurneisser, *Leonhart.* Pison. Das erst Theil. Von Kalten, Warmen, Minerischen und Metallischen Wassern, sampt der vergleichunge der Plantarum und Erdgewechsen 10 Bücher: Durch Leonhart Thurneisser zum Thurn, mit grosser mühe und arbeit, gemeinem nutz zu gut an tag geben. Mit Röm. Kay. May. freyheit auff 10 Jar. 1572. Gedruckt zu Franckfurt an der Oder, durch Johan Eichorn. Folio. pp. [xx] + ccccxx + [liii].

—— : מֶלִיצָת KA'I 'EPMHNE'IA. Das ist ein Onomasticum und Interpretatio oder aussführliche Erklerung, Uber Etliche frembde uñ (bey vielen hochgelarten, die der Lateinischen und Griechischen Sprach erfahren) umbekante Nomina, Verba, Proverbia, Dicta, Sylben, Caracter, und sonst Reden. Deren nicht allein in des theuren Philosophi und Medici Aurelij, Theophrasti, Paracelsi von Hohenheim, Sondern auch in anderer Authorum Schrifften, hin und wider weitleufftig gedacht, welche hie zusammen, nach dem Alphabet verzeichnet. Das Ander theil. In welchem fast jedes Wort, mit seiner eigenen schrifft, nach der Völcker Etymologia oder eigenen art und weis zureden, beschrieben worden ist. Gedruckt zu Berlin durch Nicolaum Voltzen 1583. Folio. pp. [xii] + 188.

Bound with **Thurneisser**, *L.*, Vel Magna Alchymia.

—— ΜΕΓΑΛΗ ΧΥΜΙΑ, Vel Magna Alchymia. Das ist ein Lehr und unterweisung von den offenbaren und verborgenlichen Naturen, Arten und Eigenschafften, allerhandt wunderlicher Erdtgewechssen, als Ertzen, Metallen, Mineren, Erdsäfften, Schwefeln, Mercurien, Saltzen und Gesteinen. Und was der dingen zum theil hoch in den Lüfften, zum theil in der Tieffe der Erden, und zum theil in den Wassern, welche aus dem Chaos oder der Confusion, und vermischung Elementischer Substanzen, als Geistlicher, uñ doch subtiler, noch unbestendiger weis verursacht, empfangen und radicirt, Aber von Himelischer zuneigung der Influentischen impression, oder Eintruckung, Seelischer und Fixer oder bestendiger weise, zu einer wesentlichen materia digerirt, coagulirt, oder præparirt, Und durch die natürliche Vermögligkeit, Krafft und forthtreibung, jedes in seiner gestalt, Als ein greiffelichs, eintzigs, wesentlichs ding, Corporalischer, volkommener weise, von seiner Radice abgelöset, an tag aussgestossen, und in gestalt einer sichtigen Massæ geboren: Und wie, oder welcher gestalt, oder auff was weiss uñ wege, deren ein jedes, mit zusatz des andern, durch Menschlichen Handgriff, oder den Usum (dieser sehr

alten Kunst) eintweders in ein Liquorem, Oehl, Saltz, Stein, Wasser, Schwefel, Mercurium oder andere Mineren und Metall verwandelt, oder sonst zum nutz, gebrauch und wolstandt, Menschlichs zeitlichs Lebens zugericht und bereitet wird. Gedruckt zu Berlin durch Nicolaum Voltzen. 1583. Folio. pp. [xii]+144+[xii].

Tiffereau, *C. Théod.* Die Golderzeugung auf künstlichem Wege ist thatsächlich erwiesen. Die Metalle sind keine einfachen, sondern zusammengesetzte Körper. Aus dem Französischen. Berlin, 1855. 8vo. pp. 29.

[**Trissmosin,** *Salomon.*] Aureum Vellus Oder Guldin Schatz und Kunstkammer: Darrinen der aller fürnemisten, fürtreffenlichsten, ausserlesenesten, herrlichisten und bewehrtestē Auctorum Schrifften und Bücher, auss dem gar vraltē Schatz der uberblibnen, verborgnen, hinderhaltenen Reliquien und Monumenten der Aegyptiorum, Arabum, Chaldæorum & Assyriorum Königen und Weysen. Von dem Edlen, Hocherleuchten, Fürtreffenlichen, bewertē Philosopho Salomone Trissmosino (so dess grossen Philosophi und Medici Theophrasti Paracelsi Præceptor gewesen) in sonderbare underschiedliche Tractätlein disponiert, und in das Teutsch gebracht. Sampt anderen Philosophischen alter unnd newer Scribenten sonderbaren Tractätlein, alles zuuor niemalen weder erhört noch gesehen, wie der Catalogus zuverstehen gibt. Durch einen der Kunst liebhabern mit grossem Rosten, Mühe, Arbeyt und Gefahr, die Originalia und Handschrifften zusammen gebracht, unnd auffs trewlichest und fleissigst an Tag geben. Getruckt zu Rorschach am Bodensee. 1598. 4o. Tract I, pp. [viii]+117. Tract II, pp. [ii]+102. Tract III, pp. 248 (Gg *is wrongly imposed*). [Hand-coloured woodcuts.]

A detailed list of contents is given in **Ferguson,** *J.*, Bibliotheca Chemica, Vol. II, p. 469.

Tritheim, *Johann.* *See* **Schaubert,** *Johann.*

Trium Virorum Chymicorum clarissimorum, nehmlich Amadei Friedlibii, Davidus Rebentrosts und Doctor George Keilings Collectanea curiosa de Bismutho, Das ist Etliche rare, biss anhero noch nie bekannt, sondern sehr geheim gehalten gewesene chymische Processe, Wovon auch bey denen Autoribus Chymicis nicht die allergeringste Meldung zu finden, Welche vorietzo allen Liebhabern der edlen Chymie als besondere Arcana und in der Praxi niemahls fallibel befundene Processe, durch den Druck communiciret worden. Dressden und Leipzig, bey Gottfried Leschen, 1718. 8o. pp. 88.

Bound with **Hellwig,** *Johann Otto,* Arcana maiora.

Trommsdorff, *Johann Bartholomäus.* Taschenbuch für Aerzte, Chemiker u. Pharmazeutiker auf das Jahr 1803. Erfurt. 8o. pp. [xxiv]+iv+176.

Uhr-alter Ritter-Krieg, das ist, Ein Alchymistisch kürtzliches Gespräch unsers Steins, des Goldes und des Mercurij, von der wahren Materij, daraus der Stein der Weisen von den Naturkündigern durch gebührliche Handgriffe mit Hülffe des Lunischen Vulcani bereitet wird von einem alten wohlerfahrnen Philosopho beschrieben. Hamburg, In Verlegung Georg Wolffs, Buchändl. in S. Johañis-Kirchen, 1680. 8o. pp. 16.

Bound with **Suchten**, *Alexander von*, Chymische Schrifften, 1680.

Usufur womit ein vornehmer Italiänischer Fürst von einem vermeinten Chymico listiger Weise betrogen worden. Vor einigen Jahren Welsch, nun aber Teutsch publicirt. So als ein Anhang zum Fegefeuer der Chymisten dienen kan. Franckfurt und Leipzig, zu finden im Taubrischen Buchladen, 1717. 8o. pp. [24].

Bound with **Hellwig**, *Johann Otto*, Arcana maiora.

Valentinus, *Basilius*. Chymische Schriften alle, so viel derer verhanden, anitzo zum Ersten mahl zusammen gedruckt, auss vielen so wol geschriebenen als gedruckten Exemplaren vermehret und verbessert und in Zwey Theil verfasset. Hamburg, In Verlegung Johann Naumans und Georg Wolff, 1677. 8o. pp. [vi]+446+[xxiv], 400+[xxviii].

—— Chymische Schriften, aus einigen alten MSten aufs fleissigste verbessert, mit vielen Tractaten, auch etlichen Figuren vermehret, und nebst einem vollständigen Register in drey Theile verfasset: Samt einer neuen Vorrede, von Beurtheilung der alchymistischen Schriften und dem Leben des Basilii begleitet von Bened. Nic. Petræo. Fünfte Edition. Hamburg, bey Gottfried Richter. 1740. 8o. pp. [clvii]+1133+[clvii].

Vigani, *John Francis*. Medulla chymiæ, variis experimentis aucta, multisq; Figuris illustrata. Londini, Impensis Henrici Faithorne, & Joannis Kersey ad insigne Rosæ in Cæmeterio D. Pauli, 1683. 8o. [16]+71.

Wiegleb, *Johann Christian*. Historisch-kritische Untersuchung der Alchemie, oder der eingebildeten Goldmacherkunst; von ihrem Ursprunge sowohl als Fortgange, und was nun von ihr zu halten sey. Weimar, bey Carl Ludolf Hoffmann, 1777. 8o. pp. [xxii]+437+[iii].

—— *See* **Boerhaave**, *Hermann*.

Wilson, *George*. A compleat course of chymistry, containing near three hundred operations; several of which have not been publish'd before. Also, the structure of several furnaces, with near three hundred characters, which are dispers'd in chymical authors; and such instruments and vessels as are necessary in a compleat elaboratory. London: printed, and sold at the Author's house in Well-Yard, near

St. Bartholomew's Hospital; and by Walter Kettilby at the Bishop's Head in St. Paul's Church Yard, 1699. 8o. pp. [xvi] + 358.

Zetzner, *Lazarus*. *See* **Theatrum Chemicum**.

Zimmermann, *Johann Christian*. Allgemeine Grundsätze der theoretisch-practischen Chemie, das ist: Gründlicher und vollständiger Unterricht der Chémie: in welchem nicht nur überhaupt eine gründliche Anleitung zu allen Theilen der Chemie; sondern auch die, aus allen dreyen Natur-Reichen, vorkommende Operationes und Producta chemica mit vernünfftigen physicalischen Demonstrationibus und richtigen Experimentis auf die leichteste und sicherste Art abgehandelt und gelehret werden; nebst beygefügten Medicinischen, Chirurgischen, Oeconomischen, Metallurgischen &c. Gebrauch und Anwendung Herausgegeben von Johann Christian Zimmerman, Dresden, 1755. 4o. pp. [vi] + 22 + 1020 [wanting, pp. 1021 to end].

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 26/10/06

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 314.

The following are abstracts of papers received during the vacation, and published or passed for publication in the *Transactions*.

151. "Some new derivatives of di*cyclo*pentadiene." By Alexander Rule.

The author has prepared a *nitrosobromide* of di*cyclo*pentadiene similar to the nitrosochloride described by Kraemer and Spilker, and also the corresponding derivatives of mono*cyclo*pentadiene. Attempts were made to prepare oxime derivatives, but the yields in each case were poor.

By treating the nitrosobromide with alcoholic sodium ethoxide, an *ethoxyisonitroso*-derivative was obtained, whilst the *oxynitroso* derivative itself was prepared by treating the pyridinium compound of the nitrosochloride with moist silver oxide.

In neither case was it possible to obtain a ketone by further reactions, owing to the instability of the substances.

The piperidine base prepared from the nitrosochloride is a well-characterised derivative and forms a sparingly soluble *hydrochloride*. On reduction with sodium in alcoholic solution it is partially converted into a *diamine* base, which forms an easily soluble *hydrochloride* and a crystalline *platinichloride*.

152. "Some derivatives of 2- and 3-phenanthrol." By Herbert Henstock.

2-Phenanthryl ethyl ether was nitrated by adding nitric acid to its solution in glacial acetic acid, and the *nitro*-derivative yielded an

amino-compound with tin and hydrochloric acid. When this was treated with nitrous acid, the *diazo*-compound, $OEt\cdot C_{14}H_8\cdot N_2\cdot SO_4Na,6H_2O$, was obtained.

The nitro-compound of the 3-ethyl ether similarly yielded an *amino*-derivative which can be diazotised.

The 3-nitro-compound, on heating with dry bromine under pressure, gave a 2 : 7-*dibromo*-derivative. By oxidation of the 3-ethyl ether with chromium trioxide a phenanthraquinone was obtained which, on treatment with hydroxylamine hydrochloride, yielded a *monoxime*.

153. "Steric hindrance in the naphthalene series." By Clarence Smith.

Sodium β-naphthylamine-8-sulphonate forms diazoamines with benzene- and *p*-toluene-diazonium chlorides, both being yellow, crystalline substances; the former melts and decomposes at 224°, the latter at 219°.

Potassium dimethyl-β-naphthylamine-8-sulphonate,

$$SO_3K\cdot C_{10}H_6\cdot NMe_2,$$

obtained from dimethyl sulphate and β-naphthylamine-8-sulphonic acid in alkaline solution, forms colourless crystals easily soluble in water or alcohol. An intermediate product in the preparation, probably *anhydrotrimethylaminonaphthalenesulphonic acid*,

$$C_{10}H_6\begin{cases}SO_3\\ NMe_3\end{cases},$$

is an exceedingly deliquescent, colourless, crystalline substance, soluble in water, insoluble in organic solvents, but has not yet been obtained in the pure state.

The *acid*, $SO_3H\cdot C_{10}H_6\cdot NMe_2$, forms colourless needles, is sparingly soluble in cold water, dissolves readily in hot water or alcohol, forming solutions with a fine blue fluorescence, and does not react with diazonium salts.

p-*Tolylazo*-8-*nitro*-β-*naphthylamine*, $C_7H_7N_2\cdot C_{10}H_5(NO_2)NH_2$, forms reddish-brown crystals with a green reflex and melts at 253°.

The influence of steric hindrance is very obvious when the rates are compared at which "G" and "R" salts respectively combine with *p*-toluenediazonium chloride. With approximately one-twentieth molecular solutions, the reaction was complete within five minutes in the latter case, whereas in the former, after fourteen hours, 39 per cent. of the diazonium salt, estimated as *p*-tolylazo-β-naphthol, was still uncombined. With a one-fiftieth molecular solution of "G" or "R" salt, after twenty-four hours the amounts of free diazonium salt were 31·0 and 0 per cent. respectively.

Sodium 1-bromo-β-naphthol-8-sulphonate, $SO_3Na\cdot C_{10}H_5Br(OH),3H_2O$,

obtained from bromine and sodium β-naphthol-8-sulphonate in aqueous solutions, forms colourless, glistening leaflets; the halogen is not displaced by diazo-complexes.

154. "Electrolytic reduction. I. Aromatic aldehydes." By Herbert Drake Law.

By the electrolytic reduction of aromatic aldehydes, compounds of the hydrobenzoin type were obtained, the reaction proceeding according to the equation $2X{\cdot}CHO + 2H = X{\cdot}CH(OH){\cdot}CH(OH){\cdot}X$. Such substituted groups as $-OH$, $-OCH_3$, $-O_2{:}CH_2$, exercise no influence whatever on this reaction; thus vanillin, salicylaldehyde, and piperonal yielded compounds of the above type. Ketones, however, do not show this regularity, the substance formed being contaminated with further reduction products.

155. "Electrolytic reduction. II. Use of electrodes." By Herbert Drake Law.

The velocity of a chemical reaction at the electrodes in an electrolytic experiment is regulated by the rate of diffusion of the solute and may be represented by the following differential equation:

$$\frac{dc}{dt} = K(C - C'),$$

C and C' being the concentrations before and after the experiment. Where C' is small, then by substitution of the hydrogen equivalent for C the following equation results:

$$\frac{1}{Hc} \log \frac{H}{H-h} = K.$$

H represents the hydrogen absorbed at any time, Hc the total hydrogen required, and h the amount already used. When C' is small, the velocity is almost independent of the potential of the hydrogen, but otherwise this factor must be taken into account. Further, we have:

$$C - C' \propto 2C' \times P_H,$$

where P_H is the potential factor (*Analyst*, 1906, **31**, 3). This, introduced into the above equations, represents the complete action in the absence of catalytic agents.

156. "Studies on optically active carbimides. Part IV. The resolution of *ac*-tetrahydro-2-naphthol by means of *l*-menthylcarbimide." By Robert Howson Pickard and William Oswald Littlebury.

ac-Tetrahydro-2-naphthol has been resolved in a similar manner to α-phenyl-α'-4-hydroxyphenylethane (this vol., 71).

d-*ac-Tetrahydro-2-naphthol* l-*menthylcarbamate*, separated from the corresponding (*ll*) *carbamate* by fractional crystallisation from alcohol, melts at 131° and has $[\alpha]_D - 33{\cdot}4^\circ$ in chloroform.

d-*ac-Tetrahydro-2-naphthol* is a pale yellow oil, which has $[\alpha]_D + 28{\cdot}2^\circ$ in chloroform and $[\alpha]_D + 27{\cdot}6^\circ$ in benzene. The *phenylcarbamate* melts at 115—117° and has $[\alpha]_D + 25{\cdot}2^\circ$ in chloroform.

157. "Tetrazoline. Part IV." By Siegfried Ruhemann.

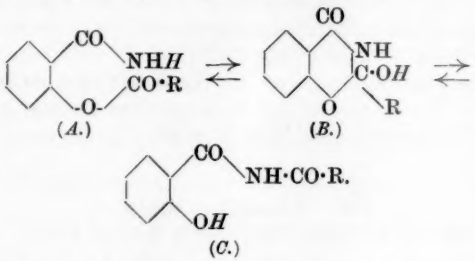
The author showed that the compounds $C_5H_{11}N_4I$ and $C_5H_{11}N_4I_3$, which *C*-dimethyltetrazoline, $CH_3{\cdot}C\begin{matrix}N{\cdot}NH\\ NH{\cdot}N\end{matrix}C{\cdot}CH_3$, forms with methyl iodide, have properties unlike the corresponding substances $C_3H_7N_4I$ and $C_3H_7N_4I_3$, which are obtained from tetrazoline (Ruhemann and Merriman, Trans., 1905, **87**, 1768). A difference between tetrazoline and *C*-dimethyltetrazoline has also been observed with regard to the condensation products which these bases yield with aldehydes. The substance which is formed from salicylaldehyde and *C*-dimethyltetrazoline has the composition $C_{11}H_{12}ON_4,H_2O$; it therefore contains 1 molecule of water, which it loses at 100°, and its solution in dilute hydrochloric acid does not give a precipitate with platinic chloride. These properties differ from those of salicylidene tetrazoline and its analogues (*loc. cit.*). On account of these facts the author adheres to the view that the condensation products of aldehydes with tetrazoline are to be represented thus: $R{\cdot}CH{:}C\begin{matrix}N{=}N\\ NH{\cdot}N\end{matrix}CH$.

Bisdiazomethane, $CH_2\begin{matrix}N{:}N\\ N{:}N\end{matrix}CH_2$, condenses with only 1 molecule of an aldehyde to form compounds of the formula $R{\cdot}CH{:}C\begin{matrix}N{:}N\\ N{:}N\end{matrix}CH_2$, which are readily hydrolysed. Their solutions in dilute hydrochloric acid do not yield precipitates with platinic chloride.

158. "Labile isomerism among acyl derivatives of salicylamide." By James McConnan and Arthur Walsh Titherley.

The authors have made a further study of the constitution of Gerhardt's benzoylsalicylamide, which is a tautomeric substance

behaving both as *N*-benzoylsalicylamide and the cyclic metoxazone derivative, $C_6H_4<^{CO\cdot NH}_{O-C(OH)Ph}$. In general, acyl derivatives of salicylamide show remarkable labile characters, and the changes which they undergo may be expressed by the scheme:



The possibility of individual existence of *N*-acylsalicylamides apparently depends on the nature of R, and, in general, varying degrees of stability of the types *A*, *B*, and *C* appear according to the nature of this group and according to whether the residual hydrogen atom of the NH group is further replaced.

In the case of O-*acetylsalicylamide* (m. p. 138°), which readily rearranges, the intermediate metoxazone derivative is too unstable to exist and N-*acetylsalicylamide* (m. p. 147°) results. *O*-Benzoyl-*N*-acetylsalicylamide (m. p. 96°) passes with extreme ease into N-*acetyl*-2 : 2-*phenylhydroxybenzometoxazone* (m. p. 106°), which readily reverts to the open-chain isomeride (m. p. 96°). O-*Acetyl*-N-*benzoylsalicylamide* (m. p. 124°) rearranges less easily than its isomeride melting at 96°, yielding, however, the same metoxazone derivative. *NN*-Diacyl salicylamides, $C_6H_4<^{CO\cdot N(CO\cdot R)_2}_{OH}$, are apparently too unstable to exist, the tendency to rearrange being so great that the isomeric metoxazone derivative, $C_6H_4<^{CO\cdot N\cdot CO\cdot R}_{O-C(OH)R'}$, is formed, which in its turn may rearrange, yielding the open-chain derivative $C_6H_4<^{CO\cdot NH\cdot CO\cdot R}_{O\cdot CO\cdot R}$.

159. "The action of nitrous acid on the arylsulphonylmetadiamines." By Gilbert Thomas Morgan and Frances Mary Gore Micklethwait [with E. G. Couzens].

The arylsulphonyl derivatives of the ortho- and para-diamines having been shown to yield characteristic diazoimides on treatment with nitrous acid, a series of the arylsulphonylmetadiamines,

$$R\cdot SO_2\cdot NH\cdot X\cdot NH_2,$$

was examined in order to ascertain whether their diazonium chlorides, $R{\cdot}SO_2{\cdot}NH{\cdot}X{\cdot}N_2Cl$, would give rise to diazoimides. The monobenzenesulphonyl derivatives of tolylene-2 : 4-diamine, 4 : 6-diamino-*m*-xylene, and diaminomesitylene were prepared and subjected to the action of nitrous acid in hydrochloric acid solution; their diazonium chlorides, which were stable in acid solution or in the dry state, underwent decomposition at the ordinary temperature on treatment with sodium acetate, evolving at least 50 per cent., and in some cases even the whole of the diazo-nitrogen, and leaving either arylsulphonylaminophenols or ill-defined azo-derivatives or mixtures of these substances. In no case could any diazoimide be detected.

160. "Dinaphthacridines."

By Alfred Senier and Percy Corlett Austin.

The authors have made a further study of the interaction of methylene di-iodide on naphthylamines, which was introduced by one of them and Goodwin in 1902 as a general method of acridine synthesis. They have also found the requisite conditions for the substitution of methylene dichloride for the di-iodide and of its analogues, ethylidene chloride and benzal chloride, in the synthesis of dinaphthacridines, which renders the preparation of the $\begin{matrix}\alpha\text{-N-}\alpha\\ \beta\text{-CH-}\beta\end{matrix}$ dinaphthacridine much easier.

The notation employed is that proposed by Senier (*Brit. Assoc. Report*, 1903, 616; *Chem. News*, 1903, **88**, 272).

When methylene dichloride and α-naphthylamine were heated in a closed tube at 230°, $\begin{matrix}\alpha\text{-N-}\alpha\\ \beta\text{-CH-}\beta\end{matrix}$ dinaphthacridine was formed. It distils unchanged, melts at 185·5° (189° corr.), not at 173° as previously stated, exhibits triboluminescence, and yields an *aurichloride*.

$\begin{matrix}\alpha\text{-N-}\beta\\ \beta\text{-CH-}\alpha\end{matrix}$ Dinaphthacridine, prepared by the methylene dichloride and other new methods, distils unchanged, is not triboluminescent, melts at 223° (228° corr.), and forms a *platinichloride* and *bisdinaphthacridine hexabromide*.

$\begin{matrix}\beta\text{-N-}\beta\\ \alpha\text{-CH-}\alpha\end{matrix}$ Dinaphthacridine (β-naphthacridine, Reed) was prepared by the action of methylene dichloride on β-naphthylamine in a closed tube. It is not triboluminescent. Using methylene di-iodide, it was found that, by varying the conditions of the experiment, (1) Reed's base alone, (2) Morgan's base chiefly, or (3) a mixture of the two, could be obtained.

Methyldinaphthacridine, obtained from ethylidene chloride and α-naphthylamine, forms greenish-yellow octahedra melting at 219° (224° corr.), which are not triboluminescent.

The *hydrochloride*, *aurichloride*, *platinichloride*, and *dibromide* were described.

Phenyldinaphthacridine, prepared from benzal chloride and α-naphthylamine in presence of naphthalene, forms yellow, hexagonal plates, which are not triboluminescent and melt at 224° (229° corr.). It yields a *hydrochloride*, *platinichloride*, and *aurichloride*.

Phenyldinaphthacridine was prepared from benzal chloride and β-naphthylamine. It is not triboluminescent and melts at 293°, (301·5° corr.).

161. "The relation of position isomerism to optical activity. VII. The rotation of the menthyl esters of three isomeric dinitrobenzoic acids." By Julius Berend Cohen and Henry Percy Armes.

The menthyl esters selected for investigation were those of the 2 : 4-2 : 6-, and 3 : 5-dinitrobenzoic acids. In a previous communication on this subject (*Trans.*, 1905, **87**, 122) it was shown that of the three mononitro-esters the ortho-compound produced the greatest rotation and the para- the least, the meta-ester lying between the two. The present results agree with the former observations. The di-ortho-compound has the highest molecular rotation, $[M]_D - 642°$, and the di-meta- the lowest, $[M]_D - 246°$, whilst the compound which contains one nitro-group in the ortho- and one in the para-position has a constant which is nearly the mean of the other two, namely, $[M]_D - 470°$. At the conclusion of the paper, one of the authors draws attention to the evidences of steric hindrance which are afforded by the action of di-ortho-substituted acid chlorides on menthol.

162. "The properties of 2 : 3 : 4 : 5-tetrachlorotoluene. A correction." By Julius Berend Cohen and Henry Drysdale Dakin.

In a paper on the chlorination of the trichlorotoluenes (*Trans.*, 1904, **85**, 1274) it was stated that whereas 3 : 4 : 5-trichlorotoluene was converted on chlorination into a tetrachlorotoluene (m. p. 97—98°) which gave a nitro-derivative melting at 159°, 2 : 3 : 4 : 5-tetrachlorotoluene from 2 : 4 : 5-trichloronitrotoluene melted at 86—88° and gave a nitro-derivative having the same melting point. It is now found that the

latter observation is incorrect, and that the tetrachlorotoluene obtained from 2 : 4 : 5-trichloronitrotoluene is identical with that prepared by the chlorination of 3 : 4 : 5-trichlorotoluene.

163. "A method for the formation of succinic acid and of its alkyl derivatives." By Annie Higson and Jocelyn Field Thorpe.

The cyanohydrins of aldehydes and ketones readily react in the cold with the sodium derivative of ethyl cyanoacetate, forming the sodium derivatives of dicyano-ethyl salts in accordance with the general equation:

$$CO_2Et\cdot C(CN)NaH + HO\cdot C(CN)RR' = CO_2Et\cdot C(CN)Na\cdot C(CN)RR' + H_2O.$$

The free ethyl salts can be prepared from these sodium derivatives on treatment with acids, and on hydrolysis may be converted into the corresponding derivatives of succinic acid.

The following cyanohydrins have been investigated:

Formaldehydecyanohydrin	giving	succinic acid.
Lactic nitrile	,,	methylsuccinic acid.
Acetonecyanohydrin	,,	*asym*-dimethylsuccinic acid.
Methylethylketonecyanohydrin	,,	methylethylsuccinic acid.
Œnantholcyanohydrin	,,	hexylsuccinic acid.
Mandelic nitrile	,,	phenylsuccinic acid.

It is further pointed out that the sodium compound which is formed in the condensation may be treated directly with an alkyl iodide, and in this way further alkylated derivatives of succinic acid can be prepared. For example, *cis*- and *trans*-dimethylsuccinic acids were obtained from lactic nitrile and trimethylsuccinic acid from acetonecyanohydrin, in each case by treating the sodium compound formed in the condensation of these cyanohydrins and ethyl sodiocyanoacetate with methyl iodide and hydrolysing the product.

164. "The gum of *Cochlospermum Gossypium*." By Henry Haliburton Robinson.

A small tree, *Cochlospermum Gossypium*, yields a gum which resembles tragacanth in absorbing a large quantity of water and swelling up to many times its original size; it is also remarkable for its property of slowly giving off acetic acid.

By hydrolysing the gum with dilute sulphuric acid, a dibasic acid of the formula $C_{23}H_{36}O_{21}$ was obtained, for which the name *gondic acid* is proposed. Gondic acid is soluble in water, and is precipitated from

its aqueous solution by alcohol as a white, amorphous substance; by evaporation it is obtained in colourless, transparent flakes. Like gum arabic, it gives a solution having adhesive power. When dried at 100°, 100 parts of the acid neutralise 23·7 parts of barium oxide, and the rotatory power is $[\alpha]_D + 97·7°$; it forms salts by addition and not by replacement, thus the barium salt is $C_{28}H_{36}O_{21},BaO$.

From the liquids from which the gondic acid had been separated, two sugars were obtained; one of these was xylose and the other was a hexose, possibly galactose, although it presented some differences.

The original gum yielded 14 per cent. of acetic acid. By prolonged treatment with cold sodium hydroxide solution and then acidifying and dialysing, a clear, viscid, colloid solution was obtained containing a de-acetylated product, which can be precipitated by alcohol in presence of hydrochloric acid. This substance, for which the name *α-cochlosperminic acid* is proposed, gelatinises with water, but does not dissolve.

165. "Studies in the acridine series. Part IV. The methylation of chrysophenol." By Albert Ernest Dunstan and John Theodore Hewitt.

In previous communications, anhydro-bases have been described resulting from the acetylation of 2-amino-3 : 7-dimethylacridine, benzoflavine, and chrysaniline, conversion into quaternary ammonium compounds, and subsequent removal of the acetyl groups (Trans., 1904, **85**, 529; 1905, **87**, 1058, and 1906, **89**, 482). Fischer and Körner (*Ber.*, 1884, **17**, 203; *Annalen*, 1886, **226**, 175) examined the chrysophenol which Claus had produced by heating chrysaniline with hydrochloric acid under pressure. The present authors conclude that it is the amino-group in the acridine nucleus which is displaced by hydroxyl, and regard chrysophenol as 2-hydroxy-5-*p*-aminophenylacridine.

This base gave a *diacetyl* derivative which, when treated with dimethyl sulphate, yielded a quaternary ammonium salt. On removal of the acetyl groups, salts of a base were obtained which, when first liberated, is soluble in excess of alkali as well as of acid. This is probably 2-*hydroxy*-5-p-*aminophenyl*-10-*methylacridanol*-5; on drying at 100° it gave an *anhydro*-base, $C_{20}H_{16}ON_2$. Various derivatives of chrysophenol, the *acetyl* compound, and the *base* $C_{20}H_{16}ON_2$ were described, and the solutions of the different substances have been examined with regard to fluorescence.

166. "Optically active reduced naphthoic acids. Part III. The relative catalytic effect of bases on the compounds of Δ^2-dihydro-1-naphthoic acid." By Robert Howson Pickard and Joseph Yates.

Sodium *d*-Δ^2-dihydro-1-naphthoate is transformed in aqueous solution in the presence of hydroxyl ions to the salt of the corresponding Δ^1-acid. The "strengths" of various inorganic and organic bases as regards this specific reagent have been compared and found to correspond roughly with those deduced from the electrical conductivities. The influence of sodium chloride on the velocity of the transformation is very similar to its influence on the velocity of the catalytic hydrolysis of methyl acetate. There is no difference in the rate of transformation of the sodium salts of the dextro- and lævo-acids.

The methyl ester of the *d*-Δ^2-acid is transformed in the presence of an organic base in an anhydrous organic solvent with a much greater velocity than the transformation of the sodium salt in water.

The mechanism of the two transformations is probably different, the ester being transformed in the presence of a tertiary base.

167. "Estimation of copper by titanium trichloride." By Ezra Lobb Rhead.

Copper may be quickly and accurately estimated by means of a standard solution of titanium trichloride in presence of potassium thiocyanate.

Cupric salts are reduced and the copper precipitated as cuprous thiocyanate in presence of either sulphuric or hydrochloric acid. The end of the reaction may be rendered more distinct by adding a ferrous salt, either mixed with the standard solution or separately. Cupric salts oxidise ferrous salts, and a red colour is produced with the thiocyanate present; its discharge marks the end of the reaction, which is perfectly sharp.

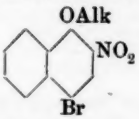
The titration is conducted below 30°, and the whole of the reagent added as quickly as possible.

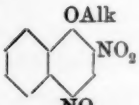
Ferric and cupric salts may be estimated together, and the amount of iron deducted after being separately determined.

The new method is as accurate as the electrolytic and iodometric methods, and free from the objections and difficulties attaching to them.

168. "Notes on derivatives of α-*N*-alkylated naphthylamine."
By Raphael Meldola.

Naphthalene derivatives of the types





are characterised by the extreme mobility of the alkyloxy-group, which is readily exchanged for the alkylamino-group when the compounds in question are treated in alcoholic solution with amines of the type $R{\cdot}CH_2{\cdot}NH_2$. By this means, 2 : 4-*dinitro-α-ethylnaphthylamine* (m. p. 169—170°) and 4-*bromo*-2-*nitro*-α-*benzylnaphthylamine* (m. p. 126—127°) and some of their derivatives have been prepared.

The following note has been received during the vacation:

169. "Note on a compound of thiocarbamide and potassium iodide."
By Emil Alphonse Werner.

While studying the interaction of iodine and thiocarbamide in aqueous solution, the author incidentally obtained *tetra-thiocarbamide potassium iodide*, $(CSN_2H_4)_4KI$, analogous to the tetra-thiocarbamide ammonium bromide, $(CSN_2H_4)_4{\cdot}NH_4Br$, prepared and described by Emerson Reynolds (*Trans.*, 1891, **59**, 385). It is formed quantitatively when hot solutions of the separate substances in absolute alcohol are mixed; the new compound crystallises as the liquid cools, in long, delicate, interlacing needles melting at 189—190° and possessing a beautiful satiny lustre, resembling the ammonium bromide compound.

0·3 distilled with an excess of ferric sulphate solution gave 0·08108 iodine. I = 27·03.

$C_4H_{16}N_8IS_4K$ requires I = 27·02 per cent.

The substance is dissociated in dilute aqueous solution, but may be crystallised from a very concentrated solution without sensible decomposition.

All attempts to prepare an analogous, or indeed any compound, from thiocarbamide and sodium iodide were unsuccessful, such a sharp difference in the behaviour of the potassium and sodium salts being rather remarkable.

The compound with ammonium iodide (m. p. 186°) has already been prepared. Potassium bromide and thiocarbamide combine only with difficulty.

Thursday, October 18th, 1906, at 8.30 p.m., Professor Sir WILLIAM RAMSAY, K.C.B., F.R.S., Foreign Secretary, in the Chair.

PRESENTATION OF THE LONGSTAFF MEDAL.

In the absence of the President through illness, the following address from him was communicated :

The Longstaff Medal, as announced last Session, has been awarded to Prof. Walter Noel Hartley for his researches in Spectro-chemistry. It is over a quarter of a century since Hartley first entered this domain of physical chemistry which he has since cultivated with unremitting zeal and conspicuous success. To him belongs the distinct credit of being among the first to realise that valuable information concerning the constitution of chemical compounds might be obtained by the study of their absorption spectra, not only within the region of the visible spectrum, but, what is of far greater importance, in that ultra-violet region which is so easily dealt with by the photographic plate. His first contribution (in conjunction with Prof. Huntingdon) appeared in 1879, and must be regarded as the pioneer research which laid the foundation of all subsequent work in the systematic study of absorption spectra carried out by Hartley himself in conjunction with various collaborators or by independent workers inspired by the success of the method. The merits of this first memoir and of all the results which have followed from it consist not only in the establishment of the principle of a relationship between a particular optical property of a molecule and its chemical structure, but in the practical development of the methods by which this principle has been established. Setting out originally with the object of studying the ultra-violet absorption spectra of compounds of known constitution by means of the photographic plate, Hartley was soon compelled to turn his attention to emission spectra, and his well-known tin-lead-cadmium alloy was devised and used as a means of supplying spark spectra rich in ultra-violet lines of known wave-lengths. His later incursions into this field of spectroscopy are sufficiently well known. It is only necessary to refer to his spectrographic method of studying alloys and his researches on flame spectra and their applications to mineral analysis and to metallurgical processes. While there is no branch of spectro-chemistry which he has handled to which Hartley has not made valuable contributions, it is for the long series of researches on the relationship between absorption spectra and chemical constitution commencing in 1879 and continuing down to his latest communication published in last year's volume of our *Transactions* that the Longstaff Medal is more especially awarded. Although associated with many

colleagues in the course of this work, the main source of inspiration has doubtless been Hartley himself. By his labours he has placed in the hands of chemists a method of studying chemical constitution which must for all time be taken into consideration. It is not only the method itself, but the mode of expressing the results by what he called "curves of molecular vibration" that first enabled chemists to realise the power of the new weapon. The continuous series of investigations proceeding from Hartley and his colleagues since 1879, and the more recent and no less important contributions now being made by other workers in the same field, all bear witness to the fertility of this spectroscopic method. An appeal to the more modern literature of the subject will show that not only has the original conception of the pioneer been amply justified, but that his methods have shown themselves capable of dealing with the more recondite problems of isomerism and tautomerism in its various aspects and the relationship between colour and chemical constitution. It is perhaps safe to say that no discussion on this latter subject can lead to definite conclusions if absorption spectra be ignored.

In presenting the Longstaff Medal to Prof. Hartley it will doubtless be the unanimous desire of the Fellows of the Chemical Society that the presentation should be accompanied by the wish that he may long be spared to carry on that branch of physico-chemical work of which he is practically the founder, and with the development of which his name will always be honourably associated to the lasting credit of British Science.

The Longstaff Medal was then presented to Professor Walter Noel Hartley by the Chairman, and duly acknowledged.

Messrs. G. H. A. Clowes, B. Flurscheim, S. S. Pickles, H. Rogerson, and H. W. M. Willett were formally admitted Fellows of the Society.

The Chairman stated that on the occasion of the Jubilee of the Foundation of the Coal-Tar Colour Industry celebrated in July, the following address was presented to Sir William H. Perkin by the President:

To William Henry Perkin, LL.D., Ph.D., F.R.S.,
From the Chemical Society.

Among those who congratulate you on the occasion of the celebration of the fiftieth anniversary of your discovery of the first Coal-Tar Colour, the Chemical Society is not only aware of your great services

to Chemical Science and Chemical Technology but may claim to know you more intimately than can any other body. Elected a Fellow in the year in which you began to manufacture Mauve, you are one of its oldest members; as one of its Secretaries during the years 1869–83, and as its President in 1883–85, you have rendered most valuable service in the conduct of its affairs; but it is chiefly for your many contributions to its *Proceedings* that it is indebted to you. Singularly consistent in your choice of the Society's publications as the means of making your work known, you have at all times been one of the chief supporters of its efforts to promote the progress of Chemical Science.

It is impossible to overrate the value directly and indirectly of your discovery; the evidence of the influence which it has exercised is overwhelming. And it is noteworthy that you should have been active not only at the beginning of the colour industry but that you have more than once intervened to assist its progress; notably by the part which you took in the development of the manufacture of the Madder colours; by your work on Cinnamic acid, which was of critical importance in the early stages of the development of the artificial indigo industry; and by your discovery of a method of producing Coumarin artificially, which entitles you to rank as the pioneer in the establishment of an important offshoot of the colour industry, that of artificial perfumes.

The extraordinary progress of Chemical Science during the past half century indeed is in a very large measure the outcome of your discovery; had it not been proved to be a useful science, Chemistry would never have attracted the army of workers whose victories have led to the marvellous developments which are to be chronicled on every side. The advance of knowledge is little short of miraculous, especially in view of the difficulties with which chemists are confronted.

But however highly your technical achievements be rated, those who have been intimately associated with you must feel that the example which you have set by your rectitude as well as by your modesty and sincerity of purpose is of chiefest value. That you should have been able, as a very young man, to overcome the extraordinary difficulties incident to the establishment of an entirely novel industry fifty years ago, is a clear proof that you were possessed in an unusual degree of courage, independence of character, judgment, and resourcefulness; but even more striking is your return into the fold of scientific workers and the ardour with which you have devoted yourself to the prosecution of abstract physico-chemical inquiries of exceptional difficulty. In the account of your renowned Master, Hofmann, you have stated that one of your great fears on entering into technical work was that it might prevent your continuing research work; that you should have felt such regret at such a period is sufficiently remarkable

and it must be a source of enduring satisfaction to you to know that your later scientific work deserves, in the opinion of many, to rank certainly no less highly than your earlier.

It is with a feeling of just pride that the Chemical Society now places on record its deep sense of the obligation which you have laid upon it by having won for British Chemical Science the incomparable distinction of making so great a step in the progress of civilisation as is marked by your discovery and its consequences.

Signed on behalf of the Chemical Society this Twenty-sixth day of July, 1906,

RAPHAEL MELDOLA, *President.*
ALEXANDER SCOTT, *Treasurer.*
M. O. FORSTER, } *Honorary*
ARTHUR W. CROSSLEY, } *Secretaries.*
WILLIAM RAMSAY, *Foreign Secretary.*

It was also announced that during the celebration by the University of Aberdeen of its Fourth Centenary, the following address was presented in the name of the Society by the President:

TO THE UNIVERSITY OF ABERDEEN.

On behalf of the Chemical Society we beg to offer our most hearty congratulations to the University of Aberdeen on the occasion of the celebration of its Fourth Centenary. At an early period in its history the University gave prominence to Chemistry and by so doing has rendered the greatest service to our Science as an educational subject. The University Chair of Chemistry has been filled successively by a number of distinguished men, Fellows of our Society, many of whom have extended the boundaries of Scientific Knowledge by their original investigations.

The inauguration of the new buildings will be regarded as marking the commencement of a new period of useful activity in the educational history of this country. The establishment of the new Laboratories will give the greatest satisfaction to English Chemists as it is recognised that the improved facilities for instruction and research thus placed at the disposal of the University will insure the future development of their Science in Aberdeen, both as a branch of Academic Learning and as a subject of the greatest importance to the material welfare of the Nation.

In the name of the Council and Fellows of the Chemical Society we desire to place on record our most sincere wishes for the continued

prosperity of the University of Aberdeen, both in our own Department of Scientific Knowledge and in all those studies which during the four past centuries it has fostered with such conspicuous success.

Signed on behalf of the Chemical Society this Twenty-sixth day of July, 1906,

RAPHAEL MELDOLA, *President.*
ALEXANDER SCOTT, *Treasurer.*
M. O. FORSTER, } *Honorary*
ARTHUR W. CROSSLEY, } *Secretaries.*
WILLIAM RAMSAY, *Foreign Secretary.*

Certificates were read for the first time in favour of Messrs. :

Paul Seidelin Arup, M.A., Marsden Villa, 62, Haverstock Hill, N.W.
Oscar Walter Bethea, Meridian, Miss., U.S.A.
James Spears Broome, B.Sc., 18, Seedley Park Road, Pendleton, Manchester.
Thomas Henry Byrom, 31, Wrightington Street, Wigan.
John Carmichael, 10, Cortayne Road, Fulham, S.W.
Percy Henry Carpenter, A.I.C., 46, Streathbourne Road, Upper Tooting, S.W.
Charles Taylor Cockburn, 34, Queen's Gate, Dowanhill, Glasgow.
Hubert Frank Coward, M.Sc., Hulme Hall, Plymouth Grove, Manchester.
Archibald Prideaux Davson, A.R.C.S., 39, Blandford Square, N.W.
Anthony Nisbet Fitzgerald, B.A., B.Sc., 12, St. Mary's Road, Strood, Rochester.
Octavius Hall, L.R.C.S., L.R.C.P., 6, Devonshire Villas, Plymouth.
H. Norman Hanson, Field Head, Brighouse, Yorks.
Charles Percy Hines, B.Sc., The Grammar School, Dartford.
Edward Rees Jones, Llangedwyn Vicarage, Oswestry.
William Richard Simpson Ladell, 19, Alwyne Road, N.
David McIntosh, B.Sc., Stamford School, Stamford.
John Mastin, Woodleigh House, Totley Brook, Nr. Sheffield.
George Naylor, 45, Hornby Road, Blackpool.
Charles Harold Oxland, B.Sc., 37, Waterloo Road, Bedford.
Frederic Ion Richardson, B.A., Glenarbor, Kew, Nr. Melbourne, Australia.
Reginald Ernest Robinson, B.A., The Villas, Stoke-on-Trent.
John Lionel Simonsen, M.Sc., 152, Barlow Moor Road, West Didsbury, Manchester.
Charles Smith, Knowsley Road, Smithells, Bolton.
Harry George Telling, Cooksbridge, Sussex.
George Gordon Watt, 26, Albert Square, Clapham Road, S.W.
Chr. Winther, The University, Copenhagen.

Of the following papers, those marked * were read :

***170. "The description and spectrographic analysis of a meteoric stone." By Walter Noel Hartley.**

This stony meteorite was seen to fall in the Kangra Valley, Northern Punjaub, in 1897, and was received in the same year from Lt.-Colonel Donald St. John Dundas Grant, of the India Medical Service. It consists of a crystalline stony base, throughout which are dispersed bright silvery metallic particles from 0·5 to 1 mm. in diameter. The analysis was carried out according to the method previously described (Hartley and Ramage, *Trans.*, 1901, **79**, 61). The principal constituents of the metallic portion are iron, nickel, cobalt, and chromium, with small quantities of copper, silver, lead, and gallium. Manganese, calcium, potassium, and sodium are present only in minute proportions. The chief components of the silicates other than silica are calcium and magnesium oxides. The bases present in minute proportions are iron, nickel, chromium, strontium, lead, silver, manganese, potassium, and sodium.

***171. "Malacone, a silicate of zirconium containing argon and helium." By Stanhope Kitchin and William George Winterson.**

This mineral, found at Hitteroe and Arendal, Norway, is radioactive and gives off a mixture of helium and *argon* when heated. As it is the only mineral from which argon has been obtained, a careful analysis was made with the object of seeing whether the presence of any unknown or unusual constituent would account for the presence of the argon. The analysis, discounting ferric oxide, uranium oxide, &c., points to the ratio $3ZrO_2 : 2SiO_2$ between the zirconia and the silica. The zirconia, converted into the basic chloride $ZrOCl_2$ and fractionally crystallised, was found to give the ratio 1 : 2 between the zirconium and chlorine, taking the atomic weight of zirconium at its accepted value, 90.

The mineral is feebly radioactive, and its radioactivity is considerably higher than that deduced from its content of uranium; but it still remains to make a careful examination of the nature of the emanation evolved, which, although it has a considerable period of decay, has not been proved to be identical with that from radium.

***172. "The relationship of colour and fluorescence to constitution Part I. The condensation products of mellitic and pyromellitic acid with resorcinol." By O. Silberrad.**

Mellitic and pyromellitic acids condense with resorcinol to form compounds analogous to fluorescein.

Mellitic acid forms three series of products, namely, mono-, di-, and

tri-xanthydryl derivatives, of which the dixanthydryl derivatives exist in two modifications, namely, meta and para. Pyromellitic acid forms mono- and di-xanthydryl derivatives. Representatives of all of these classes have been prepared.

One of the chief interests of the work lies in its bearing on the quinone theory of the structure of the phthaleins. Many of the compounds described do not admit of formulation on the quinone type, but are nevertheless intense colouring matters and strongly fluorescent. The analogy between these compounds and the phthaleins is so close that it appears very probable that the latter also contain no quinone group.

Indications have also been obtained that the change from a lactonic structure to that of a carboxylic acid and *vice versâ* does not take place with the ease which has generally been assumed; this also has an important bearing on the supposed tautomerism of the phthaleins.

The structure of the melliteins and pyromelliteins follows in general from the method of preparation and the results of analysis. In the case of the dixanthydryl derivatives, it was necessary to differentiate between the meta- and para-isomerides, by determining whether they were capable of further combining with resorcinol.

The following compounds, together with their *potassium*, *lithium*, *ammonium*, *copper*, *lead*, *mercury*, *barium*, *cobalt*, *iron*, and *silver* salts, were investigated:

3 : 6 : 9-*Trihydroxyxanthydrylbenzene*-2-*carboxylactone*-4 : 5-*dicarboxylic acid*, together with its *tetrabromo*- and *tetraiodo*-derivatives.

3 : 3′ : 6 : 6′ : 9 : 9′-*Hexahydroxy*-m-*dixanthydrylbenzene*-2 : 4 : 5 : 6-*tetracarboxylic acid* and its *octobromo*-derivative.

3 : 3′ : 6 : 6′ : 9 : 9′-*Hexahydroxy*-p-*dixanthydrylbenzene*-2 : 3 : 5 : 6-*tetracarboxylic acid*.

3 : 3′ : 3″ : 6 : 6′ : 6″ : 9 : 9′ : 9″-*Nonohydroxy*-sym-*trixanthydrylbenzene*-2 : 4 : 6-*tricarboxylic acid*, together with its *dodecabromo*- and *dodecaiodo*-derivatives.

*173. "Separation of αα- and ββ-dimethyladipic acids." By Arthur William Crossley and Norah Renouf.

Experiments were described by which it has been found possible, contrary to the statement of Blanc (*Bull. Soc. chim.*, 1905, [iii], **33**, 879), to separate αα- and ββ-dimethyladipic acids. The method depends on the different solubilities of these two acids in water saturated with hydrogen chloride and in a mixture of chloroform and light petroleum.

***174. "Action of alcoholic potassium hydroxide on 3-bromo-1 : 1-dimethylhexahydrobenzene." By Arthur William Crossley and Norah Renouf.**

Further investigation of 1 : 1-dimethyl-Δ^3-tetrahydrobenzene (*Trans.*, 1905, **87**, 1499), prepared by the action of alcoholic potassium hydroxide on 3-bromo-1 : 1-dimethylhexahydrobenzene, has shown it to be a mixture of this hydrocarbon with the isomeric 1 : 1-dimethyl-Δ^2-tetrahydrobenzene, in which the former always predominates.

This has been rendered possible by the discovery of a means of separating the oxidation products of these two substances, namely, $\alpha\alpha$- and $\beta\beta$-dimethyladipic acids.

***175. "The conversion of morphine and codeine into optical isomerides. (Preliminary communication.)" By Frederic Herbert Lees and Frank Tutin.**

It was demonstrated by Schryver and Lees (*Trans.*, 1900, **77**, 1024, and 1901, **79**, 563) that the chloro- and bromo-derivatives of morphine and codeine of the respective types $C_{17}H_{18}O_2N{\cdot}X$ and $C_{18}H_{20}N{\cdot}X$, prepared and described by them (*loc. cit.*), do not regenerate simply the original bases when they are hydrolysed by water. In every case a mixture of bases isomeric with the parent substance was produced, and of these *iso*morphine, *β-iso*morphine, and *iso*codeine were isolated and described. As *iso*morphine appeared to be the chief product of the action of water on bromomorphide (m. p. 170°) it was fully studied in order to obtain information respecting its relation to morphine. Of the two theories advanced respecting this relation, that of stereoisomerism was at the time considered to be the less probable.

From the consideration of the fact that Schryver and Lees demonstrated a complete chemical analogy between morphine and *iso*morphine (compare also Knorr and Hawthorne, *Ber.*, 1902, **35**, 3010), and that the only differences between the bases are of a purely physical character and such as are found among optical isomerides, the present authors conclude that the isomerism must without doubt be optical in character. Experimental evidence confirming this view has now been obtained.

Since the scope of the present investigation, on which the authors have been engaged for some time, has necessarily become extended to a study of the products of the hydrolysis of all the mono-halogen derivatives of morphine and codeine, they intended to delay publication until the whole subject was completed. The appearance, however, of a recent paper by R. Pschorr (*Ber.*, 1906, **39**, 3130), entitled "Halogen

Derivate von Morphin und Codein und deren Abbau," from which it is evident that the halogen derivatives obtained by Schryver and Lees are receiving attention, renders it desirable that the authors should publish some of their results and conclusions in order to indicate the lines on which they are still working.

Bromocodeide (m. p. 162°), on hydrolysis with water, gives an optically active mixture consisting, in unequal proportions, of bases isomeric with codeine. By fractionally crystallising the mixture from ethyl acetate and from alcohol, until products were obtained which showed no change in melting point and specific rotatory power, the following substances were isolated :

A-Base.—This formed slender, prismatic needles melting at 145—145·5°, and had $[\alpha]_D$ – 205° in chloroform.

B-Base.—This formed colourless, tabular prisms melting at 171—172°, and had $[\alpha]_D$ – 155° in chloroform.

When codeine is treated with excess of phosphorus tribromide in chloroform, the reaction is most vigorous, and bromination is almost immediately complete. When this solution is heated on a water-bath for a quarter of an hour instead of for one hour, as was previously the case, the resulting bromo-derivative apparently contains less of the crystalline bromocodeide (m. p. 162°) and is a mixture. When this product is hydrolysed with water and the resulting mixture of isomeric codeines fractionally crystallised, codeine (m. p. 155°, $[\alpha]_D$ – 122°) was isolated in addition to the above-mentioned A- and B-bases.

The substance described above as the B-base has now been shown to be *iso*codeine, the codeine analogue of *iso*morphine, for it is readily produced from the latter by methylation with sodium ethoxide and dimethyl sulphate. The *iso*codeine obtained by Schryver and Lees (*loc. cit.*) was apparently contaminated with a small proportion of the A-base.

The A-base, although undergoing no resolution by numerous crystallisations from several solvents, has been proved to be a molecular mixture of *iso*codeine (m. p. 171—172°) and a more highly lævorotatory isomeride which has not yet been prepared in the pure state.

By the reactions mentioned, the authors have thus obtained conclusive evidence of the formation in unequal proportions of codeine and two other optically isomeric lævorotatory bases.

These facts permit of the following conclusions respecting the constitution of morphine :

(1) The above-mentioned isomeric codeines are the result of the racemisation of two asymmetric carbon atoms in a molecule which must necessarily contain a third asymmetric system.

(2) The carbon atoms which undergo racemisation are most probably those in the reduced phenanthrene nucleus to which the alcoholic

hydroxyl group and the nitrogen atom are respectively attached. It follows from this that the latter carbon atom must necessarily be hydrogenised in order to be asymmetric.

(3) The possible isomeric codeines produced by the racemisation of the two asymmetric carbon atoms must be represented by the configurations + + −, + − −, − + −, − − −, as at least three of them are lævorotatory.

176. "The aminodicarboxylic acid derived from pinene." By William Augustus Tilden and Donald Francis Blyther.

This is the acid originally obtained by Tilden and Burrows (*Trans.*, 1905, **87**, 344). In the present communication details are given for the preparation of the acid and its *hydrochloride*, *nitrate*, *acid oxalate*, *copper* salt, *ethyl* ester and its *hydrochloride*, and the *acetyl* derivative of the amino-acid.

Experiments are being continued on the products of the oxidation of the acid and of its condensation with benzaldehyde and glycocine.

177. "The preparation and properties of dihydropinylamine (pinocamphylamine)." By William Augustus Tilden and Frederick George Shepheard.

Dihydropinylamine is the chief product of the reduction of nitrosopinene by means of boiling amyl alcohol and sodium. The free base is a colourless liquid having an odour like pinylamine and boiling at 198—199°.

The *hydrochloride*, *platinichloride*, *picrate*, *nitrate*, *oxalate*, also the *acetyl* and *benzoyl* derivatives and the *carbamide*, have been prepared and analysed. The alcohol obtained by the action of nitrous acid on the aqueous solution of the hydrochloride of the base boils at 103° under 15 mm. pressure, and is identical with pinocampheol prepared by reduction of pinocamphone.

178. "Determination of nitrates." By Frank Sturdy Sinnatt.

Knecht and Hibbert's method for the estimation of picric acid (*Ber.*, 1903, **36**, 1549) may be applied to the estimation of nitrates.

The process depends on the conversion of the nitrate into picric acid by means of phenolsulphonic acid, the picric acid being subsequently estimated by titanium trichloride.

Up to the present the method has only been used for the estimation of recrystallised pure potassium nitrate; it was carried out as follows:

Ten c.c. of the solution of potassium nitrate containing 0·1 per cent. of potassium salt were evaporated to dryness in a steam oven, 5 c.c. of a solution of phenolsulphonic acid added, and the heating continued for half an hour. The whole was then washed into a flask and, after adding hydrochloric acid, titrated with titanium trichloride.

Three titrations carried out in the above manner required, for 0·01 gram of potassium nitrate, 20·14, 20·47, and 20·2 c.c. of titanium trichloride (1 c.c. = 0·0004860 gram of potassium nitrate), corresponding to 0·009788, 0·009948, and 0·009817 gram of potassium nitrate respectively. The error is not so great as when the colorimetric method is used.

179. "The nature of ammoniacal copper solutions." By Harry Medforth Dawson.

The nature and dissociation of the complex cupri-ammonia compound which is present in ammoniacal solutions of copper sulphate has been further examined. The method consisted in determining the amount of free ammonia in variously concentrated copper solutions containing different relative amounts of ammonia by extracting these solutions with chloroform. Special precautions have been taken with the view of obtaining accurate results, and a correction has been applied for the ammonia-displacing action of the dissolved salt. The experimental data indicate the existence in solution of a dissociating complex compound containing 4 molecules of ammonia per atom of copper. The ammonia dissociation increases with dilution and, for a given copper concentration, with decrease in the relative proportion of ammonia. From experiments in which the free ammonia in ammoniacal copper sulphate solutions was determined by the method of gas-bubbling, Locke and Forssall (*Amer. Chem. J.*, 1904, **31**, 268) have drawn the conclusion that such solutions contain practically the whole of the copper in the form of a stable complex ion, $Cu{\cdot}4\dot{N}H_3$. According to the author's observations, this view is quite untenable.

180. "The colouring matters of the stilbene group. Part III." By Arthur George Green and Percy Field Crosland.

In previous communications (*Trans.*, 1904, **85**, 1424, 1432) it has been shown that the first action of caustic alkalis on *p*-nitrotoluenesulphonic acid is the production of an unstable and easily oxidisable dinitrosostilbenedisulphonic acid.

In order to study the subsequent transformation of this intermediate product by which dyestuffs of the stilbene series are produced, typical

colouring matters of this class, namely, stilbene yellow 8G and 4G, direct yellow, and Mikado orange, were submitted to examination by the following methods:

A. Estimation of the quantity of hydrogen required to reduce the dyestuff to diaminostilbenedisulphonic acid, employing for this purpose titration with standard titanium trichloride.

B. Estimation of the ethylene groups by determining the quantity of standard permanganate required to oxidise the dyestuffs to aldehydes in cold dilute aqueous solution.

C. Isolation and characterisation of the aldehydes formed.

The results obtained agree with the assumption that in the second stage of transformation condensation takes place between two molecules of the intermediate dinitroso-compound in the following manner:

$$\begin{matrix}\mathrm{CH}\cdot\mathrm{C_6H_3(SO_3Na)}\cdot\mathrm{NO}\\ \|\\ \mathrm{CH}\cdot\mathrm{C_6H_3(SO_3Na)}\cdot\mathrm{NO}\end{matrix}\times 2 \longrightarrow$$

$$\begin{matrix}\mathrm{CH}\cdot\mathrm{C_6H_3(SO_3Na)}\cdot\mathrm{N{=\!=}N}\cdot\mathrm{C_6H_3(SO_3Na)}\cdot\mathrm{CH}\\ \|\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\|\\ \mathrm{CH}\cdot\mathrm{C_6H_3(SO_3Na)NO_2}\quad\mathrm{NO_2}\cdot\mathrm{C_6H_3(SO_3Na)}\cdot\mathrm{CH}\end{matrix}$$

The dinitroazodistilbenedisulphonic acid thus produced represents the structure of the greenest yellow of the series. The redder yellows and oranges are formed therefrom by the reduction of the two nitro-groups, first to an azoxy- and finally to an azo-group. The stilbene yellows 8G and 4G were proved to consist almost entirely of sodium dinitroazodistilbenedisulphonate. Direct yellow is less pure, but appears to consist substantially of sodium azoxyazodistilbenedisulphonate. Mikado orange, which could not be obtained entirely pure, gave results which approximate to those required for the diazostilbenedisulphonate.

It appears, therefore, that all the dyestuffs of the stilbene series are true azo-compounds. Their chromophor being an azo-group, their dyeing properties are now satisfactorily explained. They differ, however, from most other azo-dyestuffs in the entire absence of auxochrome groups.

181. "Interaction of succinic acid and potassium dichromate. Note on a black modification of chromium sesquioxide." By Emil Alphonse Werner.

When a mixture of finely-powdered potassium dichromate (1 mol.) and succinic acid (6 mols.) is heated, interaction takes place a few degrees above the boiling point of the acid (181°). A compound having the composition $Cr_4(C_4H_4O_4)_5,7H_2O$ is formed, which has not the properties of a chromo-organic acid. It is practically insoluble in water, and on ignition in air leaves a residue of chromium sesquioxide which is

black. The chromium hydroxide produced from it by decomposition with sodium hydroxide also leaves a jet-black modification of the sesquioxide after ignition.

182. "Derivatives of polyvalent iodine. The action of chlorine on organic iodo-derivatives, including the sulphonium and tetra-substituted ammonium iodides." By Emil Alphonse Werner.

Experiments have been made with the object of ascertaining if organic iodo-compounds other than the immediate derivatives of benzene and its homologues can form addition compounds with chlorine corresponding to the iodoso-chlorides.

Iodothiophen, C_4H_3IS (S : I = 1 : 2), and di-iodo-thiophen, $C_4H_2I_2S$, m. p. 40°, behave like open-chain compounds; on the other hand, tetraiodopyrrole, $C_4NH{\cdot}I_4$, forms the additive compounds $C_4NH{\cdot}I_4Cl_4$ and $C_4NH{\cdot}I_4Cl_8$ (m. p. 158°).

A few new iodoso-derivatives of benzene have been prepared. By the action of chlorine on the sulphonium and tetra-substituted ammonium iodides, compounds of the type $RCl{\cdot}ICl_3$ have been obtained, from which the more stable compound of the general formula $RCl{\cdot}ICl$ can be produced either by the action of heat or by treatment with a solution of sodium hydroxide.

The following *compounds* were described and their constitution discussed:

$(CH_3)_3SCl{\cdot}ICl_3$ and $(CH_3)_3SCl{\cdot}ICl$ (m. p. 103°).
$C_2H_5(C_3H_7)_3NCl{\cdot}ICl_3$ and $C_2H_5(C_3H_7)_3NCl{\cdot}ICl$ (m. p. 94°).
$(C_2H_5)C_5H_5NCl{\cdot}ICl_3$ and $(C_2H_5)C_5H_5NCl{\cdot}ICl$ (m. p. 35°).
$(CH_3)_4NCl{\cdot}ICl$ (m. p. 217°) and $(C_2H_5)_4NCl{\cdot}ICl$ (m. p. 98°).

183. "The so-called 'benzidine chromate,' and allied substances." By James Moir.

This remarkable substance, which resembles cœrulignone very closely, resulted on mixing solutions of benzidine and chromium trioxide. The author finds that it is the chromate, not of benzidine, but of a complex oxidation product of the latter, which has apparently the formula $C_{60}H_{46}N_{10}$. It behaves like cœrulignone towards sulphuric acid and towards sulphites, giving an intense crimson coloration with the former, and yielding *benzidine-2-monosulphonic acid* with the latter. The colour-base, $C_{60}H_{46}N_{10}$, appears to have resulted from the condensation of 3 molecules of diphenoquinone-di-imine (*Ber.*, 1905, **38**, 1232) with two of benzidine, in somewhat the same manner as dianilinoquinone-dianil arises from quinone and aniline. On treating with ammonia, only one molecule of benzidine separated from the C_{60} complex, and

by the action of potassium sulphite, 3 molecules of benzidinesulphonic acid were produced. "Benzidine chromate" contains 4 molecules of chromic acid, but the author has also prepared a substance containing nearly twice as much chromium, which is either $C_{60}H_{46}N_{10}\cdot 2H_2Cr_4O_{13}$ or merely diphenoquinone-di-imine sesquichromate, $C_{12}H_{10}N_2 + 1\frac{1}{2}CrO_3$.

By heating 3 : 3′-dibromo-5 : 5′-tolidine with chromic acid, a green homologue of "benzidine chromate" was obtained. Its analysis agrees with the formula $C_{60}H_{28}(CH_3)_{10}N_{10}Br_8 + 9H_2CrO_4$, which would be expected from the constitutional formula put forward by the author for "benzidine chromate."

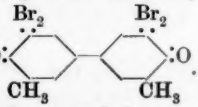
The "ferricyanide of benzidine" has also been investigated. It is similar to and contains the same colour-base as the "chromate," having the formula $C_{60}H_{46}N_{10} + 2H_3Fe(CN)_6$. The action of ammonia resulted in the separation of very little benzidine, giving chiefly another dark colour-base and ammonium ferricyanide.

184. "New derivatives of diphenol (4 : 4′-dihydroxydiphenol)." By James Moir.

By the sulphonation of diphenol the author has prepared the 3 : 3′-*disulphonic acid*, the 3 : 5 : 3′-*trisulphonic acid*, and the 3 : 5 : 3′ : 5′-*tetrasulphonic acid*.

With chlorosulphonic acid, diphenetole yielded (*a*) 4 : 4′-*diphenetole*-3-*sulphonic acid*, (*b*) 4 : 4′-*diphenetole*-3 : 3′-*disulphonic acid*, and (*c*) an indifferent *substance* containing chlorine and sulphur.

On brominating Schütz's dinitrodiphenol, a *dibromodinitrodiphenol* melting at 237° was obtained, and from dicresol the 5 : 5′-*dibromodicresol* melting at 185° was prepared; this combines with excess of bromine to form a scarlet substance analogous to tribromophenol bromide, and possessing the constitution



The *dibenzoate* of diphenol prepared by the Schotten-Baumann method melts at 241°.

185. "On the interaction of the alkyl sulphates with the nitrites of the alkali metals and metals of the alkaline earths." By Prafulla Chandra Rây and Pañchānan Neogi.

By the interaction of the sodium, potassium, barium, and calcium salts of ethyl sulphuric acid and the nitrites of the alkali metals and metals of the alkaline earths both ethyl nitrite and nitroethane were

formed. In the case of potassium ethyl sulphate and potassium or sodium nitrite, small quantities of nitrobutane were also obtained.

186. "The electrolytic preparation of dialkyldisulphides. Preliminary note." By Thomas Slater Price and Douglas Frank Twiss.

By the electrolysis of a concentrated aqueous solution of ethyl sodium thiosulphate, commonly known as Bunte's salt (*Ber.*, 1874, **7**, 646), diethyldisulphide is formed at the anode, and separates as an oily liquid on the surface of the electrolyte. The electrolysis was carried out in a beaker, the cathode consisting of a sheet of platinum foil lying close to the sides of the beaker, the anode being a piece of stout platinum wire. The solution contained a quantity of sodium bicarbonate equivalent to the Bunte's salt taken, otherwise the disulphide was decomposed by the sulphuric acid formed during electrolysis, giving the mercaptan. The current density at the anode was 100 amperes per sq. cm., and the yield was more than 50 per cent. of the theoretical. The disulphide obtained distilled almost completely at 152°. It forms a *compound* with silver nitrate, which on analysis gave Ag = 36·93. $(C_2H_5)_2S_2,AgNO_3$ requires Ag = 36·95 per cent.

Similar results were obtained by electrolysing solutions of benzyl sodium thiosulphate (Purgotti, *Gazzetta*, 1890, **20**, 24), dibenzyldisulphide being produced in a yield of more than 80 per cent.; this was crystallised from alcohol and melted at 70°. Analysis of the *compound* with silver nitrate gave Ag = 26·3. $(C_6H_5CH_2)_2S_2,AgNO_3$ requires Ag = 26·0 per cent.

This reaction is being more thoroughly investigated and extended to the preparation of other disulphides.

187. "The direct union of carbon and hydrogen at high temperatures." By John Norman Pring and Robert Salmon Hutton.

Previous work has been limited to a study of this reaction at 1200—1350° and to the investigation of the products obtained when a carbon arc is maintained in hydrogen. The authors have now supplemented these observations by working at intermediate temperatures.

For this purpose, a special form of apparatus was devised in which carbon rods, supported at the centre of a glass or metal vessel containing hydrogen, were heated to any desired temperature by the resistance which they offer to the passage of an electric current. By carrying out experiments at gradually increasing temperatures, it was

found that traces of acetylene were already formed at 1700°, and the percentage of acetylene increased fairly uniformly with the temperature up to 2800°, which was the maximum point attained. The production of acetylene at these comparatively low temperatures and independently of any of the complicated electrical phenomena which accompany the arc does not seem to have been noted previously.

The formation of methane was also carefully studied at temperatures from 1000° upwards; the amounts found were in most cases much below those indicated by Bone and Jerdan (*Trans.*, 1897, **71**, 41; 1901, **79**, 1042), and seemed to diminish as the purity of the carbon increased.

188. "The action of nitrogen sulphide on certain metallic chlorides." By Oliver Charles Minty Davis.

When nitrogen sulphide dissolved in dry chloroform is added to the tetrachlorides of tin and titanium, the pentachlorides of antimony and molybdenum, and also tungsten hexachloride dissolved in the same solvent, interaction readily takes place. With stannic chloride, antimony pentachloride, and molybdenum pentachloride, the *compounds* formed are represented by the formulæ $SnCl_4,2N_4S_4$, $SbCl_5,N_4S_4$, and $MoCl_5,N_4S_4$ respectively, but the chlorides of tungsten and titanium are first reduced before combining with nitrogen sulphide, finally giving *compounds* having the formulæ $WoCl_4,N_4S_4$ and Ti_2Cl_6,N_4S_4. These substances are decomposed on exposure to moist air with varying degrees of rapidity, and less readily when preserved beneath dry chloroform. Negative results were obtained with the trichlorides of iron, antimony, and arsenic.

189. "The determination of halogen." By James Moir.

The substance to be analysed having been weighed directly into a tall nickel crucible, ten drops of water and five to seven "pastilles" of pure potassium hydrate are added and the mixture is stirred with a platinum wire while it is heated on the steam-bath; when it is uniform, from 0·5 to 1 gram of finely-powdered potassium permanganate is stirred in, in small portions at a time; the mixture is then heated on the steam-bath until dry, being watched in case frothing occurs; it is afterwards heated slowly to visible redness or until the glowing caused by the interaction between separated carbon and manganese dioxide is over. The cool crucible is placed in a warm dilute solution of potassium bisulphite; the solution is then carefully acidified with acetic acid and filtered directly into a solution of silver nitrate. The silver halide may be worked up with nitric acid in the

usual manner, or the cooled crucible may be placed in water and the solution carefully acidified with acetic acid until the manganate is converted into permanganate; the latter is then destroyed by means of barium dioxide, the filtered solution neutralised with sodium bicarbonate and titrated, using chromate as indicator.

ERRATUM.

PROCEEDINGS, 1906, p. 203.

In the third line from top *for* "**pentamethylen**" *read* "**polymethylene.**"

At the next Ordinary Meeting, on **Thursday**, November **1st**, 1906, at **8.30** p.m., the following papers will be communicated:

"A development of the atomic theory which correlates chemical and crystalline structure and leads to a demonstration of the nature of valency." By W. Barlow and W. J. Pope.

"The explosive combustion of hydrocarbons. II." By W. A. Bone, J. Drugman, and G. W. Andrew.

"Contributions to the theory of solutions. I. The nature of the molecular arrangement in aqueous mixtures of the lower alcohols and acids of the paraffin series. II. Molecular complexity in the liquid state. III. Theory of the intermiscibility of liquids." By J. Holmes.

"The hydrolysis of nitrocellulose and nitroglycerol." By O. Silberrad and R. C. Farmer.

"The determination of the rate of chemical change by measurement of gases evolved." By F. E. E. Lamplough.

"Experiments on the synthesis of the terpenes. Part IX. The preparation of δ-ketohexahydrobenzoic acid (δ-keto*cyclo*hexanecarboxylic acid) and of γ-keto*cyclo*pentanecarboxylic acid." By F. W. Kay and W. H. Perkin, jun.

"Experiments on the synthesis of the terpenes. Part X. Synthesis of Δ^1-*m*-menthenol(8) and of carvestrene." By W. H. Perkin, jun., and G. Tattersall.

"Some derivatives of catechol, pyrogallol, benzophenone and of other substances allied to the natural colouring matters." By W. H. Perkin, jun., and C. Weizmann.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 12/11/06

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 315.

Thursday, November 1st, 1906, at 8.30 p.m. Professor R. MELDOLA, F.R.S., President, in the Chair.

The PRESIDENT referred to the loss sustained by the Society through the death, on October 19th, of Geh. Rath Professor Fedor Beilstein, who was elected an Honorary and Foreign Member on February 1st, 1883.

Messrs. H. R. Cooper, F. E. E. Lamplough, and W. H. Rawles were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.:

Richard Abegg, Ph.D., Landbergstrasse 4, Breslau, Germany.
William Heath Bayliss, Brewery House, Ashwell, Herts.
Charles George Edgar Farmer, 16, Herbert Crescent, S.W.
David Paton Grubb, B.Sc., Windsor Hill, Newry.
John Hamer, 44, Sugden Road, Clapham Common, S.W.
Alexander Edmund Middleton, 112, South Park Road, Wimbledon, S.W.
Arthur Higgs Morris, 77, Beverly Road, Bolton, Lancs.
Arthur Percival Newton, B.Sc., Red Cot, Coulsdon, Surrey.
Benjamin Dawson Porritt, 33, South Park Hill, South Croydon.
Herbert Stanley Redgrove, 137—140, Tottenham Court Road, W.
William R. R. Starling, 23, Magdalen Road, Norwich.

Of the following papers, that marked * was read:

***190. "A development of the atomic theory which correlates chemical and crystalline structure and leads to a demonstration of the nature of valency." By William Barlow and William Jackson Pope.**

The authors represent atoms in the combined state by "spheres of influence," and inquire how such spheres can be close-packed in a homogeneously symmetrical manner so as accurately to simulate crystalline compounds. An examination of the geometrical properties of close-packed assemblages of spheres shows that the atoms of the elements must be represented by spheres of influence directly proportional in volume to their fundamental valencies, and that a close-packed assemblage built up of spheres of the appropriate sizes, so as to represent some particular compound, can be partitioned into units identical with the chemical molecule, and possesses symmetry and dimensions compatible with those of the crystalline substance.

A detailed inquiry concerning benzene, triphenylmethane, naphthalene, anthracene, and their derivatives, shows that, with the inclusion of the above assumption, all the requisite data are available for precisely determining the configuration of the benzene molecule. The configuration deduced is in accordance with the crystallographic and chemical evidence and leads to an explanation of the meta-, ortho-para-law of substitution, and of other previously unexplained features of the chemistry of aromatic substances.

In addition to the geometrical property, which demonstrates that valency is a volume relation, it is shown that close-packed homogeneous assemblages of spheres possess others which lead to simple physical interpretations of multivalency and tautomerism. It is also indicated that ethylenic and acetylenic bonds and isomerism have complete analogues in peculiarities of homogeneous assemblages of spheres.

The relations briefly indicated above have been worked out in detail and are shown to be in entire agreement with the quantitative evidence afforded by the crystallographic measurements of the compounds concerned.

Discussion.

Prof. Armstrong, after expressing his opinion that the communication was one of altogether fundamental importance, in the first place referred to it as showing the extreme value to chemists of the study of crystallography—a subject of which hitherto relatively far too little notice had been taken. It was to be hoped that a sense of proportion would begin to prevail and that the study of form would now receive

proper attention. The success with which the authors appeared to have correlated crystalline form with structure was very remarkable especially their determination of the manner in which water or other complexes became attached in one particular direction to a molecule—slabwise. Perhaps the most important feature of the communication and the most interesting to chemists, at present, was the manner in which valency was accounted for as a volume property and a very ingenious explanation given of varying valency. In particular, he had been struck, when discussing the work with Prof. Pope, by the explanation which was given of the departure from the ordinary law of increase or decrease of valency by two units at a time (the law of odd or even valency) observed in the case of the simpler compounds of an element—as in the oxides of nitrogen, for example. Hitherto chemists had been forced to deal with variation of valency simply as a fact; they were now, for the first time, presented with an explanation of the cause of variation and of the manner in which this was effected.

Another point of extreme interest was the view put forward that it could not be supposed that elements preserved a constant "atomic volume," since it was often found, in cases in which the introduction of a radicle involved an alteration in volume, that the complex changed as a whole, the original form being preserved, alteration taking place proportionally along each axis.

Like the theory of structure at present in use, the mode of treatment now advocated did not enable us to deal with the dynamical side of chemical phenomena; it was to be regarded as an amplification of that theory, not as over-riding it or as proving it to be in any way inconsequent. The opportunities it afforded of discussing problems which had eluded our grasp hitherto appeared to be very numerous.

Mr. JOHN CASTELL-EVANS asked whether he had rightly understood Prof. Pope's statement relative to the substitution of two or more spheres for one? As he understood it, Prof. Pope seemed to say "that if from a closely packed aggregation of spheres one individual sphere of volume m be removed, the resulting cavity could be filled by m spheres each of unit volume and the 'close packing' be still preserved." This is not the case; if a cube, say, be described about the sphere of volume m, then into this cube m unit spheres could be packed, but certainly not into the cavity left by the removal of the original sphere.

Mr. BALY pointed out that the particular assemblage of atoms adopted by Prof. Pope for the benzene molecule would only exist in the benzene crystal. In the liquid state the molecule of benzene would probably not exist in the rigid condition pictured by the authors; there would seem to be no doubt that the molecule possesses an

inherent tendency to vibrate, this tendency being dependent very largely on the temperature. Probably the melting point of a crystal marks the temperature at which the tendency to vibrate on the part of the molecules overcomes the elastic energy of the crystalline form. Inasmuch as the reactions of benzene and its compounds usually take place with the substance in solution or in the liquid state, any property based only on the rigid structure in the crystal would not necessarily hold good. For example, the authors base an explanation of the ortho-, meta-, and para-substitution on this rigid structure. Owing to the dynamic condition obtaining during reactions this explanation would seem to fall to the ground.

Mr. WOOLHOUSE expressed surprise that in the complex $NaNO_3$ the element C with a volume of 4 could replace the N with a volume of 3, and that the element Ca with a volume of 2 could replace the Na with a volume of 1, and yet calcite could have such a similarity of crystalline form, as it is known to have, to that of sodium nitrate.

Although the replacement of N by C might leave the x, y, z ratios the same in spite of the increase of each, still the substitution of Ca for Na must result in an alteration of shape of the complex, resulting in the increase of at least one of these values.

Prof. MIERS, speaking as a crystallographer, stated his conviction that the new theory propounded by the authors was destined to be of immense value in the problems of crystal structure.

Crystallographers were accustomed to treat these as statical problems, and (largely owing to the researches of Mr. Barlow) feel fairly confident that they now know something of the manner in which the crystalline material is arranged. The principle of packing was liable to suspicion so long as there was no clue to the nature of the units, but had now acquired quite a new meaning with the valency volumes to indicate the dimensions of the bodies to be packed: so that we might now hope to realise a true model of the crystal structure.

The case of the Humite group, in which the increase of an axis is absolutely proportional to the valency volume of the introduced radicle, was in his opinion a very convincing one. The theory was one of profound interest to all students of crystals.

Dr. TUTTON said that he considered a notable advance had been made by the authors of this paper, which furnished another example of the advantages of the study of crystallography by chemists, an object which he had long been striving to further. There appeared to be three salient points in the work, the results of which were laid before the Society that evening. The first was the emphasis of the individual influence of the atom as distinguished from the properties of the molecule as a whole, and the influence of certain predominating atoms

in particular in determining those properties. This had been one of the chief results of his (Dr. Tutton's) own work on the sulphates and selenates, and the present work was based on that now absolutely incontrovertible foundation. The second point was that the teaching of the "topic axial ratios," introduced to the Society by him (Dr. Tutton) in the year 1894, simultaneously with and independently of Dr. Muthmann in the *Zeitschrift für Krystallographie*, was now advanced by the authors of the present paper a step further, inasmuch as in the formulæ for those ratios the term V respecting the molecular volume would now be replaced by W, the valency volume. Not only did this involve the remarkable geometrical explanation of valency which had been explained to them, but, and this was the third point which the speaker desired to emphasise, it enabled the ratios in question to be no longer confined to exhibiting in a highly instructive manner the structural relationships between the members of the same series of isomorphous compounds, but connected various series together and indeed, in general, enabled comparisons to be made between compounds of totally dissimilar, as well as of similar, nature. It was, therefore, obvious that a great advance in the correlation of chemical composition and crystalline form had been made.

Mr. W. Barlow pointed out that the spheres employed to picture the equilibrium conditions of the atoms must not be regarded as actually existent in nature; the actual spheres of influence of the atoms are not supposed to be separated by interstices, and the models are merely the best means that the authors have found for expressing, in a concrete form, the results of their researches. The balls used to represent the atomic spheres of influence should be made of solid soft india-rubber, so as to be elastic and deformable, but not compressible, and the close-packed assemblages, composed of balls of appropriate sizes, should be compressed to an extent which will practically annul the interstices.

Prof. Pope stated that in the substitutions referred to by Mr. Evans, the interstitial space is regarded as available for occupation by the new contents of the cavity. The total space available for the substituting spheres is thus not spherical, but of the irregular shape bounded by the curved surfaces of the enveloping spheres.

The series of substitutions as a result of which the $NaNO_3$ assemblage is converted into that of $CaCO_3$ can be performed so that the crystalline form changes but slightly, although the equivalence parameters x, y, and z increase, but remain equal to one another in accordance with the rhombohedral symmetry.

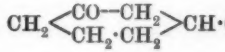
It is not claimed that the rigid assemblage of solid spheres represents accurately the condition of crystalline benzene; the spheres of atomic influence may well be regarded as domains of considerable

dynamic activity. The existence of "liquid crystals" suggests that much symmetry of arrangement occurs transiently in liquids generally, and the uniformity of chemical reaction in solution must be largely attributable to symmetry of arrangement as between reacting molecules. There is no reason to suppose that considerable change in molecular configuration attends the liquefaction of benzene; as the suggested mode of regarding the meta- and ortho-para-law only postulates symmetry of arrangement, it appears to be perfectly valid.

191. "Synthesis of carvestrene. Preliminary notice." By William Henry Perkin, jun., and George Tattersall.

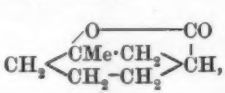
When *m*-hydroxybenzoic acid is reduced by means of alcohol and sodium, it is converted into hexahydro-*m*-hydroxybenzoic acid,

which crystallises from ether and melts at 130—132° (compare Einhorn, *Annalen*, 1896, **291**, 298). Oxidation with potassium bichromate and sulphuric acid converts this hydroxy-acid into *γ-ketohexahydrobenzoic acid*,



which had previously been obtained only in the form of a syrup. (Baeyer and Tutein, *Ber.*, 1889, **22**, 2182; Einhorn, *loc. cit.*, p. 304; Goodwin and Perkin, *Trans.*, 1905, **87**, 852). It crystallises from benzene in glistening prisms, melts at 75—76°, distils at 210° (25 mm.), and yields a *semicarbazone* melting at 182—183° with decomposition.

Ethyl γ-ketohexahydrobenzoate (b. p. 150° under 30 mm.) reacts with magnesium methyl iodide with the formation of the *lactone* of *γ-hydroxyhexahydro*-m-*toluic acid*,



a colourless oil which distils at 145° (20 mm.), and when heated with hydrobromic acid is quantitatively converted into *γ-bromohexahydro*-m-*toluic acid*,

which, so far, has only been obtained in the form of a syrup. It readily loses hydrogen bromide when treated with pyridine, and is

converted into a *tetrahydro*-m-*toluic acid* of boiling point 142—144° (15 mm.), which probably has the constitution

$$CH_2<\begin{matrix}CMe:CH\\CH_2\cdot CH_2\end{matrix}>CH\cdot CO_2H.$$

The *ester* of this acid (b. p. 128° under 60 mm.) reacts readily with magnesium methyl iodide, and is almost quantitatively converted into Δ^1-m-*menthenol*(8),

$$CH_2<\begin{matrix}CMe:CH\\CH_2\cdot CH_2\end{matrix}>CH\cdot CMe\cdot OH,$$

which had not previously been prepared. This tertiary alcohol distils at 110—112° (30 mm.), has a pleasant odour of menthol and terpineol, and when digested with potassium hydrogen sulphate is almost quantitatively decomposed with elimination of water and formation of *carvestrene*,

$$CH_2<\begin{matrix}CMe:CH\\CH_2\cdot CH_2\end{matrix}>CH\cdot CMe:CH_2.$$

The hydrocarbon thus obtained distilled at 179—180° and yielded a *dihydrochloride*, $C_{10}H_{16},2HCl$, melting at 52·5°, and a *dihydrobromide*, $C_{10}H_{16},2HBr$, melting at 48°. Its solution in acetic anhydride was coloured deep blue by the addition of sulphuric acid.

Since these properties coincide exactly with those of carvestrene, which Baeyer (*Ber.*, 1894, **27**, 3488) first prepared by the distillation of vestrylamine hydrochloride, and which Baeyer and Villiger (*Ber.*, 1898, **31**, 1402) subsequently proved to belong to the *m*-cymene series, there can be little doubt that the above experiments are to be regarded as a synthesis of this important terpene.

192. "**Some derivatives of catechol, pyrogallol, benzophenone, and of substances allied to the natural colouring matters.**" **By William Henry Perkin, jun., and Carl Weizmann.**

This communication contains the description of the preparation and properties of a number of new substances obtained at different times in connection with researches on the constitution of brazilin, hæmatoxylin, and other natural colouring matters.

193. "**Experiments on the synthesis of the terpenes. Part IX. The preparation of *cyclo*pentanone-3-carboxylic acid and of *cyclo*hexanone-4-carboxylic acid (δ-ketohexahydrobenzoic acid).**" **By Francis William Kay and William Henry Perkin, jun.**

When ethyl butane-$\alpha\beta\delta$-tricarboxylate,

$$CO_2Et\cdot CH_2\cdot CH(CO_2Et)\cdot CH_2\cdot CH_2\cdot CO_2Et,$$

is heated with sodium and the product acidified, it yields *ethyl* cyclo*pentanone*-2 : 4-*dicarboxylate*, $CO_2Et\cdot CH<\begin{matrix}CH_2\cdot CO\\ CH_2\cdot CH\cdot CO_2Et\end{matrix}$, a colourless oil, which distils at 166° (18 mm.), and, when digested with dilute sulphuric acid, is readily hydrolysed with elimination of carbon dioxide and formation of cyclo*pentanone*-3-*carboxylic acid*,

$$CO_2H\cdot CH<\begin{matrix}CH_2\cdot CO\\ CH_2\cdot CH_2\end{matrix}.$$

This new acid melts at 65°, and yields an *oxime* (m. p. 141°) and a *semicarbazone* (m. p. 195°).

When ethyl pentane-αγε-tricarboxylate,

$$CO_2Et\cdot CH_2\cdot CH_2\cdot CH(CO_2Et)\cdot CH_2\cdot CH_2\cdot CO_2Et,$$

is treated with sodium, it is converted in a similar manner into *ethyl* cyclo*hexanone*-2 : 4-*dicarboxylate*, $CO_2Et\cdot CH<\begin{matrix}CH_2\text{———}CH_2\\ CH_2\cdot CH\cdot(CO_2Et)\end{matrix}>CO$, which distils at 180° (20 mm.), and, on hydrolysis with dilute sulphuric acid, yields δ-ketohexahydrobenzoic acid,

$$CO_2H\cdot CH<\begin{matrix}CH_2\cdot CH_2\\ CH_2\cdot CH_2\end{matrix}>CO,$$

this method of preparation being much more convenient than that previously described (*Trans.*, 1904, **85**, 418). The authors wish to reserve the further investigation of the substances described in this preliminary communication.

194. "The hydrolysis of 'nitrocellulose' and 'nitroglycerine'." By Oswald Silberrad and Robert Crosbie Farmer.

The authors have studied the hydrolysis of nitrocellulose, nitroglycerine, and mixtures of the two in the form of cordite and ballistite. The hydrolysis is complicated by the simultaneous reduction of the nitric acid, as shown by (1) the formation of large quantities of nitrites, (2) the degradation of the cellulose and glycerol to hydroxy-acids, &c., (3) the abnormally high saponification equivalents found (9·2 to 9·5 for pentanitrocellulose and 4·85 for nitroglycerine), (4) the abnormality of the velocity curves. Intermediate products are formed which are gradually acted on by the alkali; these are practically insoluble in water and do not give rise to free acid when left in contact with water for several days.

With the aid of velocity determinations with varying quantities of gun-cotton, a formula was deduced whereby the velocity was calculated with which the reaction would occur if perfect diffusion took place. The following results were obtained when gun-cotton was suspended in 400 c.c. of acid or alkali at 37·8°.

Grams of gun-cotton.	Concentration of H or OH ions.	Velocity (gram-equiv. of acid liberated per hour). Calculated.	Found.
(1) *Hydrolysis by Baryta Solution.*			
3·10	0·197	0·0035	0·0033
4·97	0·191	0·0051	0·0053
20·42	0·096	0·0070	0·0071
22·10	0·189	0·0144	0·0142
∞	1·000	0·168	—
(2) *Hydrolysis by Nitric Acid.*			
5·10	0·821	0·00018	0·00018
10·00	0·821	0·00022	0·00021
20·35	0·821	0·00025	0·00024
∞	1·000	0·000347	—

From the limiting velocities thus determined, it was calculated that the hydrolysis of nitrocellulose will take place with the minimum velocity when the concentration of the hydrogen ions is $3{\cdot}7 \times 10^{-6}$ and that of the hydroxyl ions $7{\cdot}8 \times 10^{-9}$ gram-equivalents per litre. Under these conditions, the hydrolysis will proceed with such a velocity as to liberate $5{\cdot}6 \times 10^{-5}$ gram-equivalents of acid per litre of water per year.

195. "The acidic constants of some ureides and uric acid derivatives." By John Kerfoot Wood.

The investigation was undertaken with the object of determining the influence of other groups on the acidity of the imino-group. In compounds which contain the grouping ·CO·NH·CO·NH·CO·, there appears to be a mutual reinforcement of the imino-groups, analogous to the reinforcement of the carboxyl groups in succinic acid. Divergent results were obtained with barbituric and *C*-ethylbarbituric acids, the dissociation constants of which are many times greater than those of the other substances investigated; this high acidity is due to the CH_2 or $CH(C_2H_5)$ group.

196. "The affinity constants of xanthine and its methyl derivatives." By John Kerfoot Wood.

The author described the results of determinations of the basic and acidic constants of xanthine, 7-methylxanthine, the three isomeric dimethylxanthines, and caffeine. There is no great variation in the values of the basic constants, but a very striking difference in the values of the acidic constants is to be noticed. The dimethylxanthines, especially paraxanthine and theophylline, are stronger acids than any

of the other members of the series. Moreover, when the results for the three dimethylxanthines are compared amongst themselves, it is seen that they are not in agreement with the constitutions of the isomerides. The conclusion is drawn that these results are to be explained by a stereochemical influence exerted by the two methyl groups, the influence varying in magnitude according to the positions in the xanthine nucleus which the methyl groups occupy.

197. "The explosive combustion of hydrocarbons. II." By William Arthur Bone, Julien Drugman, and George William Andrew.

The authors have further examined the phenomena associated with the "inflammation" of mixtures of ethane or ethylene and oxygen corresponding to $C_2H_6 + O_2$ and $3C_2H_4 + 2O_2$ respectively, by a method which allows of discrimination between the various products according as they arise at an earlier or later stage in the flame. In each case, steam, aldehydes, ethylene, and acetylene are prominent during the initial stages of combustion, whilst carbon is a later product. Steam is so rapidly decomposed by carbon at high temperatures that prolonged duration of the flame diminishes the quantity of water which separates on cooling.

The authors have also succeeded in producing "detonation" in mixtures of ethane, or butane, and oxygen corresponding to $C_2H_6 + O_2$ and $C_4H_{10} + 2O_2$ respectively, at initial pressures of 900 mm. and upwards. The mechanism of combustion under these conditions does not, however, appear to be essentially different from what it is in ordinary flames.

198. "Contributions to the theory of solutions. I. The nature of the molecular arrangement in aqueous mixtures of the lower alcohols and acids of the paraffin series. II. Molecular complexity in the liquid state. III. Theory of the intermiscibility of liquids." By John Holmes.

The author has determined the relative densities of mixtures of carbon disulphide with ethyl- and *n*-propyl-alcohols respectively, and of pyridine with water and ethyl alcohol.

From a consideration of the nature of the volumetric changes occurring in these and other mixtures of liquids, it is concluded that the sphere of activity of a molecule is not an invariable function of the molecular volume, as ascertained from its molecular weight and specific gravity.

On these changes the author bases a theory of intermiscibility, depending on differences in the degree of repulsion between liquid molecules.

199. "The relation between natural and synthetical glycerylphosphoric acids. Part II." By Frank Tutin and Archie Cecil Osborn Hann.

With the object of ascertaining the nature of the natural and synthetical glycerylphosphoric acids, the authors have synthesised the unsymmetrical or α-acid, $OH\cdot CH_2\cdot CH(OH)\cdot CH_2\cdot O\cdot PO_3H_2$, and the symmetrical or β-acid, $(CH_2\cdot OH)_2{:}CH\cdot O\cdot PO_3H_2$, and have compared the barium and brucine salts with the corresponding salts of the natural and synthetical acids.

α-Glycerylphosphoric acid was prepared by the action of phosphoric acid on β-dichlorohydrin and subsequent hydrolysis of the product.

β-Glycerylphosphoric acid was prepared by the hydrolysis of *β-diglycerylphosphoric acid* (m. p. of calcium salt, 249—250°), which had been obtained by the action of phosphoryl chloride on α-dichlorohydrin and subsequent hydrolysis of the product.

The racemised natural acid was prepared by the hydrolysis of egg lecithin with hot baryta solution.

The synthetical acid was obtained from glycerol and phosphoric acid under such conditions as had been previously shown to give only the mono-ester.

The barium salts of these acids differ considerably in appearance, solubility, and in the amount of water they contain. The brucine salts differ in the amount of their water of crystallisation, but all melt at 157—159°, and not at 181°, as stated by Carré (*Compt. rend.*, 1903, **137**, 1070).

It is concluded from the results of this investigation that the natural and synthetical glycerylphosphoric acids are differently constituted mixtures of the α- and β-acids.

200. "Thiocarbonic acid and some of its sálts." By Ida Guenevere O'Donoghue and Zelda Kahan.

Thiocarbonic acid has been prepared by the cautious addition of calcium thiocarbonate to cold concentrated hydrochloric acid. It is a heavy, red oil, boiling with decomposition at 50°, and on distillation under diminished pressure decomposes into carbon disulphide, hydrogen sulphide, and sulphur. Thiocarbonic acid expels carbon dioxide from carbonates, and on treatment with metallic sodium or potassium

yields the corresponding salts. The normal metallic thiocarbonates are formed by the action of the salts of weak acids on thiocarbonic acid, and are constituted similarly to the corresponding carbonates. The acid has therefore the formula H_2CS_3. The salts are very unstable both in air and in a vacuum, some decompose quantitatively into carbon disulphide and metallic sulphide, whilst others give, under similar conditions, a variety of basic compounds.

201. "Studies in optical superposition. Part II." By Thomas Stewart Patterson and John Kaye.

Di-*l*-menthyl *l*-tartrate, di-*l*-menthyl diacetyl-*l*-tartrate, and sodium *l*-menthyl *l*-tartrate have been prepared and examined in regard to their optical activity, both in the homogeneous condition, so far as possible, and also in solution. The results are discussed in connection with the problem of optical superposition.

202. "Optically active dihydrophthalic acid." By Allen Neville.

When the hydrogen strychnine salt of trans-$\Delta^{3:5}$-dihydrophthalic acid is fractionally crystallised from alcohol, the acid is resolved into its lævo- and dextro-isomerides. These melt at 122° and do not lose weight at 100°. They are readily soluble in alcohol, fairly so in ether or chloroform, and insoluble in water. They have $[\alpha]_D$ about 126° in alcohol and about 140° in chloroform.

Heated with water or alkali, they pass to the optically inactive $\Delta^{2:6}$-modification and, warmed with acetic anhydride, are transformed to the *cis*-$\Delta^{3:5}$-modification of dihydrophthalic acid.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Alexeyeff, *P.* General principles of organic syntheses. Authorised translation with revision and additions by *J. Merritt* **Matthews**. pp. viii + 246. New York 1906. (*Recd.* 29/9/06.)
From the Publishers: Messrs. John Wiley & Sons.

Berthelot, *Marcellin.* Archéologie et histoire des sciences. pp. 377. Paris 1906. (*Recd.* 23/7/06.) From the Author.

Brown, *S. E.* A practical chemistry note-book for matriculation and army candidates. pp. 47. ill. London 1906. (*Recd.* 28/9/06.)
From the Publishers: Messrs. Methuen & Co.

Church [*Arthur Herbert*]. Church's laboratory guide. A manual of practical chemistry . . . specially arranged for agricultural students. Revised and partly rewritten by *Edward* **Kinch**. Eighth edition. pp. xvi + 349. London 1906. (*Recd.* 5/10/06.)
From Professor E. Kinch.

Grossmann, *J.* Ammonia and its compounds. pp. xi + 151. London 1906. (*Recd.* 28/9/06.)
From the Publishers: Messrs. Harper & Brothers.

Guttmann, *Oscar.* Monumenta Pulveris Pyrii. Reproductions of ancient pictures concerning the history of gunpowder, with explanatory notes. [Explanatory notes, 34 pp. 104 illustrations on 94 pp.] Printed for the Author at the Artists' Press, Balham, S.W. London 1906. (*Reference.*) From the Author.

Handbuch der anorganischen Chemie. Herausgegeben von *R.* **Abegg**. Band III. Abteilung I. pp. x + 466. Leipzig 1906. (*Reference.*) From the Publisher: S. Hirzel.

Institute of Chemistry. A list of official chemical appointments held in Great Britain and Ireland, in India and the Colonies. Compiled . . . by *Richard B.* **Pilcher**. pp. 123. London 1906. (*Recd.* 17/7/06.) From the Institute.

McCrudden, *Francis H.* Uric acid: the chemistry, physiology, and pathology of uric acid and the physiologically important purin bodies; with a discussion of the metabolism in gout. pp. xi + 318. New York [1906]. (*Recd.* 29/9/06.)
From the Publisher: Paul B. Hoeber.

Pellet, *H.* O acido salicylico e a questão dos vinhos Portuguezes no Brazil em 1900. Vertida para Portuguez por *A. J.* **Ferreira da Silva**. pp. xxiii + 521. Coimbra 1906. (*Recd.* 14/8/06.)
From the Translator.

Schryver, *Samuel Barnett.* Chemistry of the albumens. Ten lectures delivered in the Michaelmas Term, 1904, in the Physiological Department of University College, London. pp. 192. London 1906. (*Recd.* 7/10/06.) From the Author.

Smith, *H. Carlton.* Lecture-notes on chemistry for dental students. pp. viii + 273. ill. New York 1906. (*Recd.* 11/7/06.)
From the Publishers: Messrs. John Wiley & Sons.

Strunz, *Franz.* Ueber die Vorgeschichte und die Anfänge der Chemie. Eine Einleitung in die Geschichte der Chemie des Altertums. pp. viii + 69. Leipzig und Wien 1906. (*Recd.* 20/8/06.)
From the Publisher: Franz Deuticke.

Woods, *Hugh.* Æther: a theory of the nature of æther and of its place in the universe. pp. xii + 100. London 1906. (*Recd.* 13/8/06.)
From the Author.

II. *By Purchase.*

American Electrochemical Society. Transactions. Vol. I—III. Philadelphia 1902—3. (*Reference.*)

Ditte, *Alfred.* Étude générale des sels. 2 vols. pp. vii + 304, 383. Paris 1906. (*Recd.* 11/7/06.)

III. *Pamphlets.*

Guarini, *Emile.* L'ozone. pp. 24. Paris [1906].

Losanitsch, *S. M.* Die Grenzen des periodischen Systems der chemischen Elemente. pp. 30. Belgrad 1906.

Mingaye, *John C. H.*, and **White**, *Harold P.* Analyses of artesian and sub-artesian waters in New South Wales. pp. 5. Sydney 1906.

Rydberg, *J. R.* Elektron, der erste Grundstoff. pp. 30. Lund 1906.

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in December next. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on, or before, Monday, 10th December, 1906.

Those Fellows who received grants in December, 1905, or whose grants, allotted in December of previous years, have not been closed, are reminded that reports must be in the hands of the Hon. Secretaries not later than Saturday, 1st December next.

ERRATA.

PROCEEDINGS, 1906, p. 260.

Lines 12 and 13 from top, *for* "disulphide" *read* "ethyl sodium thiosulphate."

„ 13 from top, *for* "'the' mercaptan" *read* "'some' mercaptan."

„ 14 from top, *for* "cm." *read* "dcm."

At the next Ordinary Meeting, on **Thursday**, November 15th, 1906, at **8.30** p.m., the following papers will be communicated:

"The determination of the rate of chemical change by measurement of gases evolved." By F. E. E. Lamplough.

"Xanthoxalanil and its analogues." By S. Ruhemann.

R. CLAY AND SONS, LTD., BREAD STREET HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 23/11/06

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 316.

Thursday, November 15th, 1906, at 8.30 p.m. Professor R. MELDOLA, F.R.S., President, in the Chair.

Messrs. J. Campbell Brown and W. H. Hurtley were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. :

Frank Stanley Benton, Hurstead, Reigate.
John Trevor Cart, B.Sc., A.I.C., 4, Simonside Terrace, Heaton, Newcastle-on-Tyne.
George William Clough, B.Sc., 29, Oseney Crescent, N.W.
Victor George Jackson, 21, Frankfurt Road, Herne Hill, S.E.
Louis Murgatroyd, 1, Carlton Drive, Heaton, Bradford.
Robert Robertson, M.A., D.Sc., F.I.C., 9, Sewardstone Road, Waltham Abbey.
Arthur Henry Salway, Ph.D., B.Sc., 15, Palmerston Road, Forest Gate, E.
Robert Low Smith, 56, Genesta Road, Plumstead, S.E.
William Sandilands Templeton, M.A., B.Sc., Colombo, Ceylon.
Maximilian Toch, 261, West 71st Street, New York City, U.S.A.

A certificate was authorised by the Council for presentation to ballot under Bye-Law I (3) in favour of :
Tarak Nath Majumdar, 37, Lower Chitpore Road, Calcutta, India

Of the following papers, those marked * were read:

***203. "The determination of the rate of chemical change by measurement of gases evolved. Preliminary notice." By Francis Edward Everard Lamplough.**

The most important results of this investigation may be summarised as follows:

When a chemical reaction takes place in solution resulting in the formation of a substance which is gaseous at the ordinary temperature, the solvent becomes supersaturated with the gas.

The degree of supersaturation may be so great that the solvent contains 100 times the normal amount of the gas, and from such a solution the gas is gradually evolved.

The excess of gas so dissolved may be almost entirely expelled in thirty seconds by briskly agitating the liquid.

Investigation of the rate of decomposition of hydrogen peroxide showed that under such conditions of efficient stirring, the rate of evolution of a gas furnishes an accurate and reliable method of investigating reactions of this nature.

The decomposition of diazobenzene chloride was shown to be strictly a unimolecular reaction throughout, the rate of which is independent of the amount of acid present. The value of the constant for the reaction was found to vary with change of temperature, increasing logarithmically with increase of temperature.

The nature of the decomposition of ammonium nitrite most nearly approaches that of a quadrimolecular reaction throughout the extent of decomposition investigated.

The decomposition of formic acid by sulphuric acid is a true unimolecular reaction, and not bimolecular, as it has been hitherto considered.

The reaction between nickel carbonyl and iodine has also been studied.

Discussion.

Dr. Cain pointed out that Hantzsch had first shown that the value of the constant obtained in measurements of the rate of decomposition of diazo solutions was low at the beginning of an experiment, owing to the solubility of the nitrogen. There was no supersaturation, however, in the solutions used in the experiments by him (Dr. Cain) and Mr. Nicoll, for the deficit in the quantity of nitrogen evolved corresponded to the amount which would ordinarily remain in solution. Moreover, the values obtained for the constants agreed well with those given by Hantzsch, Euler, and other investigators.

Mr. CALDWELL asked if there were any *real* retardation of these reactions when the solutions were not stirred. The accumulation of large amounts of the gaseous product existing in a highly supersaturated state in the solution might tend to make a reaction reversible.

Mr. LAMPLOUGH in reply stated that the method adopted for the preparation of the diazobenzene chloride was that described by Dr. Cain in his paper. The solution was raised to the desired temperature in 15—30 seconds.

As evidence that supersaturation was really present the author referred to an actual comparison experiment, showing the volume of gas evolved from solutions stirred and not stirred, where it was seen from the lantern slide exhibited that at one time 37 c.c. of the solution at 62° held supersaturated 22 c.c. of nitrogen, or more than thirty times the amount calculated from the solubility of the gas. The author also gave numbers showing the great difference between his constants for the reaction and those determined by Cain and Nicoll.

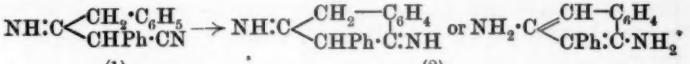
A reaction resulting in the evolution of carbon dioxide had been studied, but owing to the greater solubility, the degree of supersaturation was small, and at present the author had not sufficient data to say whether a highly supersaturated solution is more easily formed in the case of the more insoluble gases.

In the comparison experiments on the decomposition of hydrogen peroxide in which the rates of reaction were determined by measurement of the gas evolved from the stirred solution and by titration respectively, in the latter case the solution was *not* stirred, and therefore the close agreement in the results showed that the rate of evolution of gas from the stirred solution also measured truly the rate of reaction in the still liquid. Moreover, if the reaction is allowed to begin without agitation and at a given time the solution is suddenly stirred, an immediate evolution of gas takes place, making the total volume of gas evolved equal to the amount given off in the same time *with* stirring, thus showing that stirring does not influence the rate of the reaction, but simply gives a correct method of measuring it.

***204. "The formation and reactions of imino-compounds. Part II. Condensation of benzyl cyanide leading to the formation of 1 : 3-diaminonaphthalene and its derivatives." By Ernest Francis Joseph Atkinson and Jocelyn Field Thorpe.**

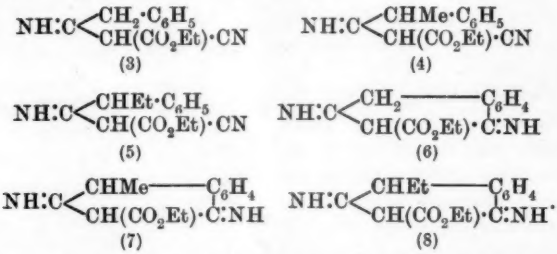
Benzyl cyanide condenses with its sodium derivative to form β-imino-α-cyano-αγ-diphenylpropane (1), which on treatment with

sulphuric acid is completely converted into 1 : 3-*diamino-2-phenylnaphthalene* (2).



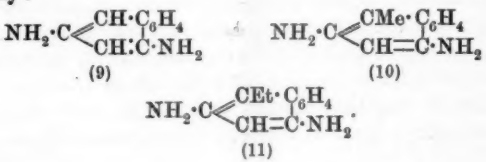
(1) (2)

Benzyl cyanide also combines with the sodium derivative of ethyl cyanoacetate, forming ethyl β-imino-α-cyano-γ-phenylbutyrate (3), from which on treatment with sodium ethoxide and either methyl or ethyl iodide, *ethyl β-imino-α-cyano-γγ-phenylmethylbutyrate* (4), or *ethyl β-imino-α-cyano-γγ-phenylethylbutyrate* (5) can be prepared. From these compounds on treatment with sulphuric acid ethyl 1 : 3-diaminonaphthalene-2-carboxylate (6), *ethyl* 1 : 3-*diamino-4-methylnaphthalene-2-carboxylate* (7), and *ethyl* 1 : 3-*diamino-4-ethylnaphthalene-2-carboxylate* (8) are formed respectively :



(3) (4) (5) (6) (7) (8)

The ethyl esters (6), (7), and (8) are converted on hydrolysis into the corresponding *carboxylic acids*, which on heating above their melting points are transformed into 1 : 3-diaminonaphthalene (9), 1 : 3-*diamino-4-methylnaphthalene* (10), and 1 : 3-*diamino-4-ethylnaphthalene* (11), respectively :



(9) (10) (11)

Discussion.

The President pointed out that the very elegant synthetical method of obtaining 1 : 3-diaminonaphthalene made known by the authors might prove of great practical use in preparing this base in quantity. The method hitherto available, in which dinitro-α-acetnaphthalide is the starting point, is both circuitous and costly.

In reply to a question from Mr. Lees, Dr. THORPE said that only primary nitriles reacted to form the imino-compounds; one of the two nitriles entering into the reaction must contain the group $CH_2 \cdot CN$.

***205. "Note on the anhydride of phenylsuccinic acid." By Francis Bernhard Dehn and Jocelyn Field Thorpe.**

The authors have investigated the anhydride of phenylsuccinic acid and conclude that it exists in only one form, which melts at 53—54°. They have been unable to prepare the other form of the anhydride melting at 150° described by Bredt and Kallen and by Wegscheider and Hecht, but by following the experimental details given by these investigators they have isolated an impure form of the acid which melts at this temperature. The authors have been unable to confirm the observation of Wegscheider and Hecht that the anhydride melting at 53—54° gradually passes into that melting at 150° when kept at the ordinary temperature and also at 100°. They have kept specimens of the pure anhydride for several months under these conditions and have observed no change.

***206. "Influence of sodium arsenate on the fermentation of glucose by yeast-juice." (Preliminary notice.) By Arthur Harden and William John Young.**

It has been previously shown that when a soluble phosphate is added to yeast-juice containing glucose, the rate of fermentation is greatly increased (5 to 10 times), and proceeds at a gradually diminishing rate until an extra amount of carbon dioxide (equivalent, molecule for molecule, to the phosphate added) has been evolved. The rate then becomes equal to, or somewhat greater than, that of the original juice to which no addition has been made. The phosphate at the same time undergoes a change which renders it non-precipitable by magnesia mixture (*Proc. Roy. Soc.*, 1906, **77**, *B*, 405).

When an equivalent amount of arsenate is substituted for the phosphate a similar acceleration is produced, but the phenomena are somewhat different. The rate is greatly increased (8 to 12 times), but this high rate continues for a considerable time without change, until many times the equivalent of carbon dioxide has been evolved, and then falls gradually, the fermentation ceasing considerably before that of a sample of the same yeast-juice to which no addition of arsenate has been made.

An example is afforded by an experiment with the undermentioned solutions:

(1) 20 c.c. of yeast-juice + 5 c.c. water + 5 grams glucose.

(2) 20 c.c. of yeast-juice + 5 c.c. $3M/10$ di-sodium hydrogen arsenate + 5 grams glucose.

The following numbers give the number of c.cs. of carbon dioxide evolved during the time given in the first column:

	c.cs. of CO_2	
Time.	Sol. 1.	Sol. 2.
1 hour	20·9	249·8
2 hours	41·2	491·5
5 „	99·5	797
6 „	118·1	831
7 „	136·2	848·8

At the end of seven hours, the rate per hour of solution 1 was still 18 c.cs. per hour, and that of solution 2 had fallen from 249·8 to 14·8.

The rate attained and the duration of the fermentation vary both with the particular specimen of yeast-juice and with the amount of arsenate added, there being a certain optimum amount of arsenate for each sample of yeast-juice. The added arsenate remains precipitable by magnesia mixture after an equivalent of carbon dioxide has been evolved, and is also still in the same form when the fermentation ceases, so that in this respect it differs from the phosphate.

207. "Xanthoxalanil and its analogues." By Siegfried Ruhemann.

When xanthoxalanil is acted on by caustic potash, it yields oxalic acid and *dianilaconitic acids* (m. p. 199—200°):

$$Ph{\cdot}N\begin{array}{l}<CO{\cdot}CH_2\\<CO{\cdot}C\end{array}\!\!=\!\!\begin{array}{l}C{\cdot}CO>\\C{-}CO>\end{array}\!\!NPh + 3H_2O =$$

$$(CO_2H)_2 + C_3H_3(CO_2H)(CO{\cdot}NHPh)_2;$$

the latter of which differs from the compound described by Michael (*Amer. Chem. J.*, 1887, 9, 193) and, on hydrolysis with hydrochloric acid, furnishes aconitic acid. *Xanthoxalo*-m-*xylidil*, $C_{24}H_{20}O_5N_2$, similarly gives *di*-m-*xylidil aconitic acid*, melting at 196—197° with decomposition. Xanthoxalanil and its analogues are transformed into colourless substances on reduction with zinc dust and acetic acid. The *compound* (m. p. 160—161°) which is thus formed from xanthoxalo-*m*-xylidil, has the formula $C_{24}H_{26}O_5N_2$.

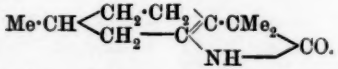
208. "Derivatives of cyanodihydrocarvone and cyanocarvomenthone." By Arthur Lapworth.

Cyanodihydrocarvone (*Trans.*, 1906, **89**, 949) yields a *cyanohydrin* which is slowly hydrolysed by mineral acids, being finally transformed into 2-*methyl*-5-iso*propenyl*-Δ^2-*tetrahydroisophthalic acid*. On reduction, the latter yields a mixture of isomeric 2-*methyl*-5-iso*propenylhexahydroisophthalic acids*, which, although still unsaturated, are not further reduced by sodium amalgam.

The addition compounds of cyanodihydrocarvone with hydrogen halides are well characterised substances which yield substitution products with bromine. The *hydriodide* may be reduced by zinc and methyl alcohol to *cyanocarvomenthone*, which may be converted by acids into *carvomenthonecarboxylic acid* and by alkalis into carvotanacetone.

209. "Reactions involving the addition of hydrogen cyanide to carbon compounds. Part VI. The action of potassium cyanide on pulegone." By Reginald William Lane Clarke and Arthur Lapworth.

The compound $C_{11}H_{17}ON$, obtained by the action of potassium cyanide on pulegone, is easily converted into *menthonecarboxylic acid* (compare Hann and Lapworth, *Proc.*, 1904, **20**, 54). The latter may be transformed into an unsaturated *lactone*, $C_{11}H_{16}O_2$, and from this, ammonia regenerates the initial substance $C_{11}H_{17}ON$, which is therefore not cyanomenthone, as was for a long time supposed, but the *anhydramide*,



This is obtained in all cases where the isomeric cyanomenthone would be the normal product.

210. "The influence of various substituents on the optical activity of tartramide." Part II. By Percy Faraday Frankland and Douglas Frank Twiss.

In continuation of the previous work of P. F. Frankland and Slator (*Trans.*, 1903, **83**, 1349), the authors have prepared and described the n- and iso*propylamides*, the *allylamide*, the n- and iso*butylamides*, and the n-*heptylamide* of tartaric acid. The rotation of these compounds has been determined in pyridine, in methyl alcohol, and, when possible, also in aqueous solutions.

All the aliphatic amides have much lower molecular rotations than

the aromatic amides. In the fatty amides of the normal series, the molecular rotation increases without exhibiting a maximum up to the heptyl term, which is as far as the series has yet been explored. The rotation of the benzylamide and furfurylamide follows closely on that of the heptylamide, there being a large gap between these and the true aromatic amides.

Special interest attaches to the lower rotation found for the allylamide than for the normal propylamide, as in general the appearance of a double bond in a compound is attended with a marked increase in the rotation.

211. "The influence of various substituents on the optical activity of malamide." By Percy Faraday Frankland and Edward Done.

The authors described the preparation and properties of the *methylamide*, *ethylamide*, and iso*propylamide*, *allylamide*, and iso*butylamide*, n-*heptylamide*, *piperidide*, and *phenylhydrazide* of ordinary *l*-malic acid. The rotation was determined in pyridine, in methyl alcohol, and in glacial acetic acid solution.

The rotation is greatly influenced by the solvent. In pyridine solution, the amides of the normal series exhibit practically no change in molecular rotation from the methyl to the heptyl term. In methyl alcohol solution, on the other hand, there is a slight rise in the value of $[M]_D$ between the methyl and heptyl terms, whilst in glacial acetic acid solution there is a slight decline over the same interval.

The allylamide has a markedly lower rotation than the normal propylamide.

The piperidide and phenylhydrazide have much lower rotations than any of the aliphatic amides; in fact, even lower than that of malamide itself.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

American Electrochemical Society. Transactions. Vol. IX. Philadelphia 1906. (*Reference.*) From Dr. F. Mollwo Perkin.

Booraem, *John V. V.* Internal energy, a method proposed for the calculation of energy stored within matter. pp. 144. New York 1906. (*Recd.* 7/11/06.) From the Author.

Gordon Memorial College, Khartoum. Second report of the Wellcome Research Laboratories. pp. 255. ill. Khartoum 1906. (*Reference.*) From the Director.

Lewkowitsch, *Julius*. Technologie et analyse chimiques des huiles, graisses et cires. Traduit . . . par *Émile* **Bontoux**. Tome I. pp. xix + 561. ill. Paris 1906. (*Recd.* 5/11/06.) From the Author.

Wilson, *Frederick Robert Leyland*, and **Hedley**, *George Ward*. Elementary chemistry. 2 vols. pp. xii + 167, xix + 382. ill. Oxford 1905—1906. (*Recd.* 7/10/06.)

From the Delegates of the Clarendon Press.

II. *By Purchase.*

Biochemische Zeitschrift. Herausgegeben von *E.* **Buchner**, *P.* **Ehrlich**, *C. von* **Noorden**, *E.* **Salkowski**, *N.* **Zuntz**. Redigiert von *C.* **Neuberg**. Band I. Berlin 1906. (*Reference.*)

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in December next. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on, or before, Monday, 10th December, 1906.

All persons who received grants in December, 1905, or in December of any previous year, and whose accounts have not been closed, are reminded that reports must reach the Hon. Secretaries not later than Saturday, 1st December next.

ERRATA.

P. 252, lines 1, 3, 18, 24, 26, 28, 30 from top, *for* "xanthydryl" *read* "xanthyl."

P. 269, line 6 from below, *for* "3" *read* "4."

P. 270, line 5 from top, *for* "3" *read* "4."

At the next Ordinary Meeting, on **Thursday**, December **6th**, 1906, at **8.30** p.m., there will be a ballot for the election of Fellows, and the following papers will be communicated:

"The liquid volume of a dissolved substance." By J. S. Lumsden.

"Some derivatives of benzophenone. Synthesis of substances occurring in coco-bark." Preliminary notice. By W. H. Perkin, jun., and R. Robinson.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Thursday, 6th December, 1906.

Abegg, Richard,

Landbergstrasse 4, Breslau, Germany.

Doctor, Professor of Chemistry in the University of Breslau. Well known as a Scientific Investigator in the domain of Physical Chemistry.

William Ramsay.	James Walker.
Arthur W. Crossley.	*M. O. Forster.*

John S. Lumsden.

Arup, Paul Seidelin,

Marsden Villa, 62, Haverstock Hill, London, N.W.

Analytical Chemist. Associate of the City and Guilds Institute. M.A., King's College, Windsor, Nova Scotia. Published Paper in *Chem. Soc. Trans.*, in conjunction with Dr. E. F. Armstrong, 1904. Formerly Demonstrator at Goldsmiths' Institute; Chemist to Messrs. Cooper and Nephews, Berkhamsted, and Lecturer in Chemistry at King's College, Nova Scotia.

Henry E. Armstrong.	William A. Davis.
Gerald T. Moody.	William Robertson.
E. Frankland Armstrong.	Robert J. Caldwell.

Bayliss, William Heath,

Brewery House, Ashwell, Herts.

Brewer and Maltster, and Brewer's Chemist. I was Chemist for

nearly three years to Messrs. H. and G. Simonds, Ltd., Brewers, Reading.

H. Cecil Seabrooke. A. Boake.
F. G. Adair Roberts. Alfred C. Young.
W. T. Wright.

Bethea, Oscar Walter, Ph.G.,
Meridian, Miss.

Pharmacist and Pharmaceutical Chemist. Professor Pharmacology Miss. Medical College. Five years' work in chemical analysis and manufacturing, and several years preceding was engaged in general pharmaceutical chemical work.

George F. Payne. Henry A. Wetzel.
Joseph P. Remington. *Virgil Coblentz.*
Ch. F. Chandler.

Broome, James Spears,
18, Seedley Park Road, Pendleton, Manchester.

Science Lecturer under Salford Education Committee. B.Sc. with 1st Class Honours in Chemistry, Victoria University of Manchester.

Harold B. Dixon. J. F. Thorpe.
W. H. Perkin, jun. Norman Smith.
G. H. Bailey. E. Green.

Byrom, Thomas Henry,
31, Wrightington Street, Wigan.

Analytical Chemist. Head Chemist to the Wigan Coal and Iron Co., Ltd. Lecturer on Theoretical and Applied Chemistry at the Wigan Technical College. Author of book, "The Physics and Chemistry of Mining."

J. E. Stead. James Smith.
R. O. Burland. *Arthur H. Tuer.*
G. Crewe Chambres.

Carmichael, John,
10, Cortayne Road, Fulham, S.W.

Analyst. Two years' study in Theoretical and Practical Chemistry at the Royal College of Science, London. Five years' analytical work in the Government Laboratory, London.

T. E. Thorpe. E. Grant Hooper.
H. W. Davis. C. Proctor.
Robert Rodger.

Carpenter, Percy Henry,

46, Streathbourne Road, Upper Tooting, S.W.

Analytical Chemist. Associate of Institute of Chemistry. Three years under Prof. Meldola at Technical College, Finsbury. Eight years as Chemical Assistant to Mr. A. C. Chapman. At present Chemist to the Cawnpore Sugar Co., Ltd.

Alf. C. Chapman.	Otto Hehner.
Fredk. T. Harry.	*W. P. Skertchly.*
F. G. S. Baker.	*M. O. Forster.*

Cockburn, Charles Taylor,

34, Queen's Gate, Dowanhill, Glasgow.

Managing Director, Cockburn & Co., Ltd., 130 to 140, Howard Street, Glasgow. Manufacturing Chemist. Member of Pharmaceutical Society. Director of the Laboratories. Desires to keep abreast of late developments in Chemistry—particularly in Physiological Chemistry.

Thomas Tyrer.	William Mair.
John C. Umney.	*Peter MacEwan.*
Thomas Morson.	*Thos. Farries.*

Cornwall, Reginald de Vere,

Salisbury, Rhodesia, South Africa.

Chemist to Medical and Public Health Department, Salisbury, Rhodesia. Pupil to Mr. Frederick Davis, B.Sc., and at Metallurgical Laboratories, King's College. Chemist to South African Saltpetre Fields, 1896–7. Present position since 1897.

W. F. Mawer.	Thos. Farries.
Leonard de Koningh.	Reginald G. Halstead.

T. Pitt.

Coward, Hubert Frank,

Hulme Hill, Plymouth Grove, Manchester.

Student. M.Sc. (Manchester). University Scholar. University Fellow in Chemistry, 1904. Assistant Lecturer in Chemistry, 1906.

Harold B. Dixon.	Norman Smith.
W. H. Perkin, jun.	D. L. Chapman.
Alfred Holt, jun.	J. F. Thorpe.

Crocker, Henry Ernest,

452, Slade Road, Gravelly Hill, Birmingham.

Analytical Chemist. Three years' Technical Education at Swansea

Municipal Technical College. Chemist for 1 year at Standard Metals Co.'s Works, Runcorn. Chief Chemist for 2½ years at Jarrow-on-Tyne Cement Works. Chief Chemist for 3½ years to General Electric Co., Limited, Witton.

G. S. Turpin. F. H. Lowe.
J. B. Coleman. W. E. Oakden.
J. C. Crocker.

Davson, Archibald Prideaux,

39, Blandford Square, London, N.W.

Assistant to R. Bodmer, Esq., F.C.S. Associate (in Chemistry) of the Royal College of Science, London. For two years assistant to Mr. Bodmer.

William A. Tilden. G. T. Morgan.
M. O. Forster. J. C. Philip.
Chapman Jones. R. Bodmer.

Dinwoodie, James Herbert,

Johannesburg.

Analytical Chemist and Pharmacist. President Transvaal Pharmacy Board.

Thomas A. Henry. William Duncan.
Peter MacEwan. Arthur W. Crossley.
Frederick B. Power.

Farmer, Charles George Edgar,

16, Herbert Crescent, London, S.W.

Undergraduate, New College, Oxford. Student.

T. C. Porter. Allan F. Walden.
H. B. Baker. N. V. Sidgwick.
S. Ruhemann. Andrea Angel.

Field, Samuel,

53, Whitburn Road, Lewisham, S.E.

Head of Department of Technical Chemistry, Northampton Institute, Clerkenwell, E.C. Assoc. Royal College of Science, 1st class, Chemistry, 1898. Late Teaching Scholar, R.C.S., London, 1898—1900. Late Lecturer in Chemistry, Central Polytechnic, Croydon.

R. Mullineux Walmsley. M. O. Forster.
Thomas Turner. *J. B. Farlie.*
A. H. Mundey. *Chas. R. Darling.*
W. E. Harrison. *H. Russell Pitt.*

Fitzgerald, Anthony Nisbet,

12, St. Mary's Road, Strood, Rochester.

Science Teacher. B.A., B.Sc. (London University), Chemistry, at final B.Sc., 1903. Teacher of Chemistry since 1900 in the Mathematical School, Rochester. Lecturer in Metallurgy, Gillingham Technical Institute, 1904–5. Lecturer in Chemistry, Chatham Technical Institute, since 1904. Formerly Student of Chemistry in Heriot-Watt College, Edinburgh, and in Battersea Polytechnic Institute.

Peter MacEwan. J. L. White.
John Wilson. *H. Wilson.*

John C. Umney.

Grubb, David Paton,

Windsor Hill, Newry.

Head Science Master, Municipal Technical School, Newry. B.Sc. (Edinburgh) in Engineering. B.Sc. (Edinburgh) in Pure Science (Chemistry in final). A.R.S.M. (London) in Metallurgy (1st Class). Science Master, Municipal Technical School, Newry.

Alex. Crum Brown. Frank W. Young.
Leonard Dobbin. W. Gowland.

W. H. Merrett.

Hall, Octavius,

6, Devonshire Villas, Plymouth.

Medical Officer of Health for the County Borough of Devonport, &c. As student, attended Course Theoretical Chemistry, University of Durham; of Practical Chemistry, King's College, London; of Analytical Chemistry as applied to Public Health requirements, University College, Bristol, and Royal College of Surgeons, Dublin. Medical Qualifications: D.P.H., L.R.C.P., L.R.C.S., L.F.P.S.G. In connection with Analytical Chemistry, am actively interested in details of Analytical Chemistry of Food, Drugs, &c., in discharge of routine duties as M.O.H. for the County Borough of Devonport, and wish to keep in touch with modern methods.

Robt. A. Bolam. Francis Francis.
Sydney Young. *W. Crabb.*

H. Lucas.

Hamer, John,

44, Sugden Road, Clapham Common, London, S.W.

Analytical Chemist and Brewer. First Class Brewer's Ordinary City and Guilds. First Class Brewer's Honours City and Guilds.

Chemist to Gillman and Spencer's (1902), Ltd., Castle Brewery Works, Southwark, London, S.E.

J. Stewart Remington.	Walter Ratcliffe.
Claude Smith.	*L. G. Radcliffe.*
Jas. Grant.	*S. J. Peachey.*
F. G. Richards.	*Thos. A. Young.*

Hanson, H. Norman,

Field Head, Brighouse.

Analytical Chemist. Three years articled pupil and one year assistant with F. W. Richardson, Esq., F.I.C., &c., and West Riding of Yorks. County Analyst, &c.; conjoint author of papers on "Chrome Estimation" (*Soc. Chem. Ind.*, May 30th, 1903) and "Valuation of Lubricants" (*S.C.I.*, April 15th, 1905); also member of the Society of Public Analysts.

F. W. Richardson.	Walter M. Gardner.
A. Jaffé.	B. North.
Lewis S. Cocking.	*L. Gordon Paul.*

Harris, Frederick James,

1, Alexandra Terrace, Bath Road, Exeter.

Associate of the City Guilds' Institute. Intermediate B.Sc., London, 1904. Engaged in Chemical Research at the Central Technical College, Exhibition Road, S.W.

Gerald T. Moody.	Edward Horton.
Henry E. Armstrong.	William Robertson.
William A. Davis.	Robert J. Caldwell.

Hines, Charles Percy,

The Grammar School, Dartford.

Assistant Master, The Grammar School, Dartford. B.Sc. (London University). Senior Science Master, Dartford, from September 1902 to present time. Junior Science Master, Bakewell Grammar School, and School of Science, 1900—1902. Studied at (i) Wellingboro' Grammar School (six years); (ii) King's College, London; Advanced Chemistry at (iii) Goldsmiths' Institute, New Cross (under Dr. Lapworth).

A. E. Barker.	J. H. Howgate.
S. G. Eade.	C. Jodrell Mansford.

William Briggs.

Johnston, Archibald McArthur,
Germiston, Transvaal, Box 108.

Metallurgical Chemist. Studied Chemistry in Glasgow and W. of Scot. Tech. Inst. Chief Assistant to Dr. J. Loevy, Gov. Analyt. Chemist, Johannesburg, 1895—1899. Head Analytical Chemist, General Mining and Fin. Corp., Johbg., 1902—1904. Chief Metall. Chem., Consol. Gold Fields, Johannesburg. Contribution and discussion before Chem. Met. and Mining Socy., Johannesburg.

W. A. Caldecott. Walter C. C. Pakes.
J. A. Wilkinson. A. L. Landau.
James Moir.

Jones, Edward Rees,
Llangedwyn Vicarage, Oswestry.

Science Master at Deacon's School, Peterboro'. Inter. B.Sc., London University. Studied Chemistry under Dr. Sudborough at Univ. College, Aberystwyth. Have been teaching Chemistry for the last seven years.

L. Hansen Bay. Wm. T. Thomson.
Wm. Barbour. *W. Rintoul.*
J. J. Sudborough. *G. H. Welsford.*

Ladell, William Richard Simpson,
19, Alwyne Road, London, N.

Analytical Chemist. Obtained the certificate of the Chemical Dept. of the Finsbury Technical College (Sessions 1903–06). Passed Intermediate A.I.C. examination.

R. Meldola. John Spiller.
John Castell-Evans. Edward Bevan.
C. F. Cross.

McIntosh, David,
Stamford School.

Science Master at above school. As Student: Four years' full laboratory training and lectures at Armstrong College, Newcastle-on-Tyne (B.Sc. with chemistry, 1902). As Teacher: Five years' daily teaching of Chemistry in secondary schools.

P. Phillips Bedson. James Leicester.
F. C. Garrett. *H. Dean.*
S. Hoare Collins. *J. T. Dunn.*

Mastin, John, F.R.M.S., &c.,
Woodleigh House, Totley Brook, near Sheffield.

Chemical Investigation and Analysis. Author of a number

of articles on chemical subjects, *e.g.*, The Composition of Steel (Metallurgical), &c. Sole patentee of two inventions for printing by chemical deposits. Sole patentee of an invention for recovery of ammonia from waste products. Sole patentee of an invention for imitation ivory from waste chemicals. Sole patentee of two inventions for chemical dyes. Sole patentee of two inventions for chemical pigments for paint. Joint patentee of four inventions for chemical pigments.

G. T. W. Newsholme. — *J. E. Alger Blyde.*
Chas. Bradshaw. — *W. T. Wright.*
G. E. Scott-Smith. — *Fredk. J. Merrils.*

Middleton, Alexander Edmund,

112, South Park Road, Wimbledon, S.W.

Analyst, Government Laboratory. Royal College of Science. Student in analytical chemistry, 2 years. Government Laboratory, 10 years.

T. E. Thorpe. — G. T. Morgan.
William A. Tilden. — M. O. Forster.

Chapman Jones.

Morris, Arthur Higgs.

77, Beverly Road, Bolton, Lancashire.

Brewer. Has been a student of chemistry at the Royal College of Science and University College, London.

Horace T. Brown. — G. T. Morgan.
William A. Tilden. — M. O. Forster.

James C. Philip.

Naylor, George,

45, Hornby Rd., Blackpool.

Pharmaceutical Chemist. Passed Major Examination of the Pharmaceutical Soc. Passed Minor Examination of the Pharmaceutical Soc. Late Chemistry Demonstrator School of the Pharmaceutical Soc. Engaged in business as a Pharmaceutical Chemist.

Arthur W. Crossley. — T. E. Wallis.
W. Palmer Wynne. — *E. Towyn Jones.*

M. O. Forster.

Newton, Arthur Percival, B.Sc. (Lond.),

Red Cot, Coulsdon, Surrey.

Lecturer in Chemistry, Morley College, London. Science Master, Strand School, King's Coll., London.

John Wilson. — G. Nevill Huntly.
J. S. White. — E. F. Harrison.

J. Hart-Smith.

Oxland, Charles Harold,

37, Waterloo Rd., Bedford.

Science Master at Wellingborough Grammar School. For four years a student in the Owens College laboratories. Bachelor of Science with Honours in Chemistry, Manchester University (1904). Appointed Science Master at the Wellingborough Grammar School in September, 1905.

H. B. Dixon. Norman Smith.
W. H. Perkin, jun. D. L. Chapman.
Alfred Holt, jun. J. F. Thorpe.

Porritt, Benjamin Dawson,

Holly Lodge, 33, South Park Hill, South Croydon.

Third year Chemical Student at University College, London.

William Ramsay. J. Norman Collie.
Samuel Smiles. N. T. M. Wilsmore.
A. W. Stewart.

Redgrove, Herbert Stanley,

137—140, Tottenham Court Road, W.

Student. Student of Chemistry; passed Inter. B.Sc. (London) with Hons. in Chemistry; Studying for Final B.Sc. Hons. in Chemistry. Desirous of obtaining benefits of the Society:—Journal, Library, Meetings, etc.

W. H. Ratcliffe. H. R. Ellis.
A. Greeves. Frank E. Weston.
F. H. Lowe.

Richardson, Frederic Ion,

"Glenarbor," Kew, near Melbourne, Australia.

Analytical Chemist. B.A. (Camb.). As I am taking up chemistry in Australia the monthly Journal of the Chemical Society will help to keep me in touch with latest knowledge.

W. J. Sell. H. O. Jones.
F. E. E. Lamplough. *R. H. Adie.*
T. B. Wood.

Robinson, Reginald Ernest,

The Villas, Stoke-on-Trent.

Chemist. 1st Class, Part I., 2nd Class, Part II., Nat. Sci. Tripos,

1900, Cambridge. Engaged in manufacture of Coal Tar and Petroleum Products.

W. J. Sell. T. B. Wood.
H. J. H. Fenton. H. O. Jones.

F. E. E. Lamplough.

Sen, Gopal Chandra,

23, Bond Street, Leeds.

Dyeworks Chemist. M.A. in Chemistry, Calcutta University Assistant to Professor Rây for two years. Now going through a special course of Dyeing and Tinctorial Chemistry in the University of Leeds.

A. G. Green. A. G. Perkin.
Arthur Smithells. A. B. Steven.

J. B. Cohen.

Simonsen, John Lionel,

152, Barlow Moor Road, West Didsbury, Manchester.

Research Fellow in Chemistry in the Manchester University. B.Sc. (1st Class Honours Chemistry), 1904. M.Sc., 1906. Joint author with Prof. W. H. Perkin, jun., of "The Replacement of Hydroxyl by Bromine," *Trans.*, 1905.

Harold B. Dixon. G. H. Bailey.
W. H. Perkin, jun. Norman Smith.

D. L. Chapman.

Smith, Charles,

Knowsley Road, Smithills, Bolton.

Science Master, Bolton Municipal Secondary School. Seven years Teacher of Chemistry, Bolton Municipal Secondary School. For four years have had charge of Chemical Laboratories. Three years Lecturer in Chemistry at the Bolton Pupil Teachers' Centre. Now engaged teaching Chemistry, twenty-four hours per week.

Charles A. Fogg. E. Boardman.
T. M. Nightingale. F. Smith.

Walter Ratcliffe.

Starling, William R. R.,

23, Magdalen Road, Norwich.

Science Master, The Grammar School, Gillingham, Dorset. 1. Intermediate Practical Chemistry, University College, Nottingham. 2. Attended Chemistry Course at Norwich Technical Institute (1900—1901). 3. (1902—3—4). University Student at Nottingham

University College. Here obtained Higher Intermediate Mathematics and Intermediate Practical Physics. 4. London University Matriculation. In July, 1905, at Inter. B.Sc., London, was accepted in Physics (Honours), Chemistry, and Mathematics. Was refused in Mechanics. 5. Science Master since Christmas, 1905, at Gillingham Grammar School, Dorset.

Hugh Ramage. Arthur Slator.
Arthur W. Mason. Philip G. G. Moon.
S. Hewitt. *Dennis Tyrrell.*

L. Archbutt.

Telling, Harry George,
Cooksbridge, Sussex.

Brewer. Matric. London Univ. First Class Honours in Brewing, City and Guilds of London. Late Laboratory Assistant to Mr. Basil Wm. Valentin. Holding numerous advanced stage certificates Science and Art Dept.; late brewer and manager to the Carmarthen United Breweries. Owner Cooksbridge Brewery, Sussex.

Basil Wm. Valentin. Francis A. B. Jewson.
W. A. S. Calder. *Thomas Edwards.*

J. M. Collett.

Thorne, Emmanuel Isaac,
13, Cantwell Road, Plumstead, S.E.

Metallurgist. Metallurgist in the Cartridge Factories, Royal Arsenal, Woolwich. Member of the Faraday Society. Honours certificates in Iron and Steel Manufacture and Chemistry; 1st Class certificates in Metallurgy, Stages II and III, and Queen's Prize, B. of E.

J. C. Aylan. H. Heron Smith.
Charles A. Keane. Godfrey Melland.
H. Burrows. W. R. Hodgkinson.
Wesley Lambert. *F. Mollwo Perkin.*

H. D. Law.

Watt, George Gordon,
26, Albert Square, Clapham Road, S.W.

Lecturer on, and Demonstrator of, Chemistry. Pharmaceutical Chemist. Member of the Pharmaceutical Society. Now, and for the past three years, Lecturer on, and Demonstrator of, Chemistry at the London College of Pharmacy.

Arthur L. W. Fechtner. Frank E. Weston.
R. Mullineux Walmsley. *Peter MacEwan.*

F. Filmer de Morgan.

Watson, Frederick William, B.Sc. (Lond.), F.I.C.,
Germiston, Transvaal, South Africa. P.O. Box, 108.

Analytical Chemist. Four years a student in the Chemical Department of the Glasgow and West of Scotland Technical College; 1 year research in the same institution under Professor G. G. Henderson. Five years' experience in Technical Chemistry. At present chief assistant to the Metallurgical Chemist of the Consolidated Goldfields of South Africa, Ltd. Wish to keep in touch with current chemical work.

W. A. Caldecott. G. G. Henderson.
A. L. Landau. Thomas Gray.
Alexander Davidson, jun.

Winther, Chr., Mag. Scient.,
Copenhagen,

Lecturer in Chemistry in the University of Copenhagen. Since 1895 I have published (mostly in the *Zeitschr. f. physikalische Chemie*) scientific work, especially on optical activity. As a lecturer in practical chemistry (since 1900) I have written a text-book of analytical chemistry, which is now used at the University of Copenhagen.

W. H. Perkin. Arthur Harden.
W. H. Perkin, jun. *Arthur Lapworth.*
Alex. McKenzie. *M. O. Forster.*

The following certificate has been authorised by the Council for presentation to ballot under Bye-Law I (3):

Tarak Nath Majumdar, L.M.S.
37, Lower Chitpore Road, Calcutta, India.

Medical Inspector of Food-stuffs, Corporation of Calcutta. Student of Chemistry, Presidency College, Calcutta, 1894—1896. Student of Chemistry, Medical College, Calcutta, 1896—1898. Passed the F.A. Examination and the Preliminary Scientific M.B. Examination (in Chemistry) of the Calcutta University in 1896 and 1898. I was engaged in the Analysis of Food-stuffs for one and half years.

J. Sen. *P. C. Ray.*
A. Ghose. *A. L. Sircar.*
Satya-prasad Sarladhicary.

R. CLAY AND SONS, LIMITED, BREAD STREET HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 15/12/06

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. **No. 317.**

Thursday, December 6th, 1906, at 8.30 p.m., Professor R. MELDOLA, F.R.S., President, in the Chair.

Certificates were read for the first time in favour of Messrs.:

George Bagley, Wellington, New Zealand.
Frank Baker, B.Sc., St. John's School, Eton.
Taylor Cook, B.Sc., 20, Sheddridge Street, Parson's Green, S.W.
Colin Ernest Dall, B.Sc., Maisonette, Maybury Road, Woking.
Frederick Alldis Eastaugh, Forty Hill, Enfield.
Edward William Lanchester Foxell, B.Sc., 22, Grand Avenue, Muswell Hill, N.
William Howieson Gibson, B.Sc., 109, Brecknock Road, Holloway, N.
Christopher Maurice Walter Grieb, B.Sc., 33, Torrington Park, Finchley, N.
William Marrs Hooton, M.A., M.Sc., Repton, Burton-on-Trent.
Arthur Vivian Hussey, Banthwaite, Belmont, Sutton, Surrey.
Ernest Wilfrid Jackson, 65, Douglas Terrace, Middlesbro'.
Albert Theodore King, B.Sc., Church Hill, Horsell, Woking.
Joseph Martin, B.Sc., Coopers' Company's School, Bow, E.
Otto Oberländer, Ph.D., Chamber of Commerce Buildings, Oxford Court, E.C.
Frederic George Percy Remfry, B.A., D.Sc., Sunnymead, Tenby.
Richard Noel Garrod Thomas, B.A., Balliol College, Oxford.
Robert Burt Wight, M.A., 3, Clarendon Terrace, Linthorpe Road, Middlesbro'.
Mark Arthur Wolff, 6, Hanover Terrace, Holland Park, W.

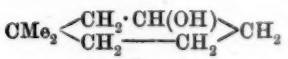
A ballot for the election of Fellows was held, and the following were subsequently declared duly elected:

Richard Abegg, Ph.D.
Paul Seidelin Arup, M.A.
William Heath Bayliss.
Oscar Walter Bethea.
James Spears Broome, B.Sc.
Thomas Henry Byrom.
John Carmichael.
Percy Henry Carpenter.
Charles Taylor Cockburn.
Reginald de Vere Cornwall.
Hubert Frank Coward, M.Sc.
Henry Ernest Crocker.
Archibald Prideaux Davson.
James Herbert Dinwoodie.
Charles George Edgar Farmer.
Samuel Field.
Anthony Nisbet Fitzgerald, B.A., B.Sc.
David Paton Grubb, B.Sc.
Octavius Hall, L.R.C.P., L.R.C.S.
John Hamer.
H. Norman Hanson.
Frederick James Harris.
Charles Percy Hines, B.Sc.
Archibald McArthur Johnston.
Edward Rees Jones.
William Richard Simpson Ladell.
David McIntosh, B.Sc.
Tarak Nath Majumdar.
John Mastin.
Alexander Edmund Middleton.
Arthur Higgs Morris.
George Naylor.
Arthur Percival Newton, B.Sc.
Charles Harold Oxland, B.Sc.
Benjamin Dawson Porritt.
Herbert Stanley Redgrove.
Frederic Ion Richardson, B.A.
Reginald Ernest Robinson, B.A.
Gopal Chandra Sen, M.A.
John Lionel Simonsen M.Sc.
Charles Smith.
William R. R. Starling.
Harry George Telling.
Emmanuel Isaac Thorne.
George Gordon Watt.
Frederick William Watson, B.Sc.
Chr. Winther, Mag. Scient.

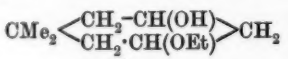
Of the following papers, those marked * were read:

***212. "Action of reducing agents on 5-chloro-3-keto-1:1-dimethyl-Δ^4-tetrahydrobenzene." By Arthur William Crossley and Nora Renouf.**

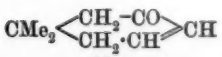
Experiments have proved that chloroketodimethyltetrahydrobenzene behaves in a varied manner towards reducing agents. Thus, sodium in moist ethereal solution (*Trans.*, 1905, **87**, 1494) gives, as main product, 3-hydroxy-1:1-dimethylhexahydrobenzene (I), whereas sodium in absolute alcoholic solution yields a small



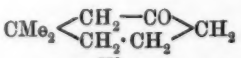
I.



II.



III.



IV.

amount of this alcohol, and to a much larger extent 3-*hydroxy*-5-

ethoxy-1 : 1-*dimethylhexahydrobenzene* (II), as a colourless liquid boiling at 135°/25 mm.

When the chloroketone is treated with zinc filings in aqueous alcoholic solution, either in the cold or on heating, 3-*keto*-1 : 1-*dimethyl*-Δ^4-*tetrahydrobenzene* (III) is formed as a colourless liquid boiling at 88·5°/32 mm., and possessing an odour of almonds and camphor. On the other hand, zinc dust in either glacial or dilute acetic acid gives rise to 3-*keto*-1 : 1-*dimethylhexahydrobenzene* (IV), boiling at 77·5°/27 mm., and having a pungent camphoraceous odour.

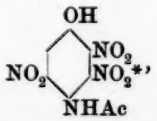
Characteristic derivatives of these various substances have been prepared, and in all cases their constitution has been conclusively proved by the oxidation products obtained from them.

In every reduction, dicyclic compounds are formed in addition to the simple ring compounds, and the following have been isolated and were described together with some of their derivatives.

3 : 3′-*Diketo*-5 : 5 : 5′ : 5′-*tetramethyl*-$\Delta^{1:1'}$-*dicyclohexene* (m. p. 178°);
1 : 1′-*dihydroxy*-5 : 5 : 5′ : 5′-*tetramethyl*-$\Delta^{2:2'}$-*dicyclohexene* (m. p. 148°);
1 : 1′-*dihydroxy*-5 : 5 : 5′ : 5′-*tetramethyldicyclohexane* (m. p. 212°);
3 : 3′-*dihydroxy*-5 : 5 : 5′ : 5′-*tetramethyldicyclohexane* (m. p. 183°).

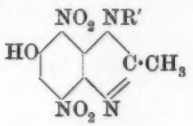
***213. "A new trinitroacetaminophenol and its use as a synthetical agent." By Raphael Meldola.**

When diacetyl-*p*-aminophenol is nitrated by dissolving it in cold fuming nitric acid the first product is the mononitro-derivative, $C_6H_3(OAc)(NO_2)\cdot NHAc = 1:3:4$, corresponding to the *m*-nitro-*p*-aminophenol of Hähle (*J. pr. Chem.*, 1891, [ii], **43**, 63; Reverdin and Bucky, *Ber.*, 1906, **39**, 2687). This mononitrodiacetyl compound can be further nitrated by dissolving it in a mixture of fuming nitric and strong sulphuric acids, when a *trinitroacetaminophenol* is produced which forms the subject of the paper communicated by the author. This trinitro-derivative, which has not hitherto been described, is remarkably active as a synthetical agent owing to the extreme mobility of one of the nitro-groups. It crystallises in yellow needles melting with decomposition at 178—179°. The constitution is shown to be



the nitro-group marked * being the mobile group. The action of

various amines on the trinitro-compound has been studied and the final products shown to be substituted benziminazoles of the type



where R′ is the radicle present in the amine used. In some cases substituted diaryl- or alkylaryl-amines are formed as intermediate products, and these undergo "anhydridisation" on heating or on treatment with dehydrating agents. The trinitro-compound reacts also with hydrazines and with certain phenolic substances, the investigation of the products being still in hand.

***214. "Pinene nitrolamine." By Frederick Peacock Leach.**

Pinene nitrosochloride, when allowed to remain at 45—50° with ammonia and alcohol, gives a well crystallised *nitrolamine*,

$$C_7H_{12}\begin{cases}C{:}NOH\\ CMe\cdot NH_2\end{cases}.$$

This compound melts somewhat indefinitely at 123—125°, contains approximately $\frac{1}{2}H_2O$, and crystallises from alcohol in long, silky needles.

The *hydrochloride*, *oxalate*, and *platinichlorides* have been prepared: the *acetyl* derivative, $C_7H_{12}\begin{cases}C{:}NOH\\ CMe\cdot NHAc\end{cases}$, crystallises in hexagonal prisms melting at 224°; the *dibenzoyl* derivative melts at 167°, and the *diphenylcarbamide* at 133°.

Pinene nitrolamine reacts very readily with aldehydes, giving well crystallised condensation products; the *benzylidene* derivative, $C_7H_{12}\begin{cases}C{:}NOH\\ C(CH_3)N{:}CHC_6H_5\end{cases}$, melts at 162°; the *salicylidene* derivative at 128°, and the *furfurylidene* derivative at 164°.

With reducing agents either no action takes place or the amino-group is eliminated, giving rise to the ketone (Wallach's pinocamphone), which has been identified by means of its oxime melting at 86°.

***215. "A *pseudo*-semicarbazide from pinene." By Frederick Peacock Leach.**

Potassium cyanate and pinene nitrosochloride interact in alcoholic solution, giving a *compound*, $C_{12}H_{17}O_3N_3$, the constitution of which is

represented by the formula $C_7H_{12}<\begin{matrix}C{=}NO{-}CO\\ |\\ CMe\cdot NH\cdot CO\end{matrix}>NH$; it crystallises from alcohol in rosettes of prisms melting at 238—240°, dissolves in dilute alkalis, and gives alkali salts. When reduced with zinc dust and dilute acetic acid, a pseudo-*carbamide* is obtained which melts at 224°:

$$C_7H_{12}<\begin{matrix}C{=}NO{-}CO\\ |\\ CMe\cdot NH\cdot CO\end{matrix}>NH+2H_2=$$

$$C_7H_{12}<\begin{matrix}CH{-}NH\\ |\\ CMe\cdot NH\end{matrix}>CO+NH_3+CO_2.$$

Concentrated sulphuric acid gives pinene nitrolamine, carbon dioxide, and ammonia. The action of nitrous acid converts the *pseudo*-carbamide into a *nitroso*-compound, which crystallises from alcohol in yellow plates with a pink lustre and melting at 161°; this on reduction gives a pseudo-*semicarbazide* melting at 209°, from which by the action of aldehydes and ketones several of the ψ-semicarbazones have been prepared and analysed.

216. "Some derivatives of benzophenone. Synthesis of substances occurring in coto-bark. Preliminary notice." By William Henry Perkin, jun., and Robert Robinson.

A mixture of veratryl chloride and pyrogallol trimethyl ether suspended in carbon disulphide reacts readily with aluminium chloride with the formation of 1 : 2 : 3 : 3′ : 4′-*pentamethoxybenzophenone*, $(MeO)_2C_6H_3\cdot CO\cdot C_6H_2(OMe)_3$, which crystallises from alcohol in prisms and melts at 125°. If, however, the reaction is prolonged, the product contains *hydroxytetramethoxybenzophenone*, which crystallises in needles, melts at 115° and is readily separated from the pentamethoxy-derivative on account of its solubility in alkalis.

When hydroxytetramethoxybenzophenone is treated with benzoyl chloride and caustic potash it yields a *benzoyl* derivative which crystallises from alcohol in stout, colourless prisms, melts at 149° and is converted into pentamethoxybenzophenone when it is treated with methyl sulphate and caustic potash.

2 : 4 : 6 : 3′ : 4′-*Pentamethoxybenzophenone* (pentamethylmaclurin), $(MeO)_2C_6H_3\cdot CO\cdot C_6H_2(OMe)_3$, is obtained when aluminium chloride reacts with a mixture of veratryl chloride and phloroglucinol trimethyl ether in the presence of carbon disulphide. It melts at 156—157° and yields a *monobromo*-derivative (m. p. 144°) when its solution in chloroform is treated with bromine, and there can be no doubt that it is identical with the substance which Ciamician and Silber (*Ber.*, 1892,

25, 1132) obtained from protocotoin, $CH_2{:}O_2{:}C_6H_3{\cdot}CO{\cdot}C_6H_2(OMe)_3$, by substituting two methyl groups for the methylene group.

Since 2 : 4 : 6 : 3′ : 4′-pentamethoxybenzophenone is pentamethylmaclurin, many attempts were made with the object of converting it into maclurin itself, but so far without success.

3′ : 4′-*Methylenedioxy*-2 : 4 : 6-*trimethoxybenzophenone*,

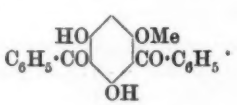
$$CH_2{:}O_2{:}C_6H_3{\cdot}CO{\cdot}C_6H_2(OMe)_3,$$

was next synthesised by treating a mixture of piperonyl chloride and phloroglucinol trimethyl ether in carbon disulphide solution with aluminium chloride. The substance so obtained melted at 133° and was identical with the oxyleucotin of coto-bark, as was shown by a careful comparison of the two preparations and by the fact that when they were mixed in equal quantities the melting point was the same as that of the constituents.

When phloroglucinol monomethyl ether, $C_6H_3(OMe)(OH)_2$, is treated with benzoyl chloride in the presence of zinc chloride, 2 : 4-*dibenzoxy*-6-*methoxy*-m-*phthalophenone*,

$$(C_6H_5{\cdot}CO)_2C_6H(OMe)(O{\cdot}CO{\cdot}C_6H_5)_2,$$

(m. p. 130—135°) is produced. This substance is readily hydrolysed by alcoholic potash with the formation of 2 : 4-*dihydroxy*-6-*methoxy*-m-*phthalophenone*, $(C_6H_5{\cdot}CO)_2C_6H(OMe)(OH)_2$, which melts at 187°, and is also produced when cotoin dibenzoate is treated with benzoyl chloride and zinc chloride. Its constitution must therefore be represented by the formula



217. "The liquid volume of a dissolved substance." By John Scott Lumsden.

The values deduced for atomic volumes and atomic refractions from experiments made on pure liquids, hold with fair accuracy when applied to solids and liquids in solution; and the inference is that a liquid retains its own volume when dissolved, and that a solid assumes in solution the volume which the same weight of it would have if it existed as a liquid at the same temperature. If this inference is correct, a law of the "liquid volume" of a dissolved substance is made evident and experimental results are recorded which prove that there is such a law which holds, not only for the volume assumed by a solid and liquid, but also for the volume occupied by a dissolved gas.

The law is expressed as follows: When a substance in the liquid state dissolves without change of volume, the same substance when in

the state of solid or gas will, when dissolved in the same solvent, change to the volume which the same weight of it would have if it were a pure liquid at the temperature of solution.

Irregularities are proved to be due to the experimentally ascertained facts that the volume in solution varies slightly with the solvent and with the degree of concentration of the solution and also from the circumstance that when a liquid is dissolved there is often a slight alteration in volume, but the deviation from accuracy from these causes is so small that the law deserves recognition as a guide when problems relating to solution in non-dissociating solvents are being dealt with.

218. "A synthesis of terebic, terpenylic, and homoterpenylic acids." By John Lionel Simonsen.

When ethyl acetylsuccinate is treated with magnesium methyl iodide ethyl terebate is obtained,

$$CO_2Et\cdot CH_2\cdot CHAc\cdot CO_2Et \longrightarrow CO_2Et\cdot CH\langle \begin{matrix} CH_2-CO \\ CMe_2\cdot O \end{matrix}.$$

In a similar manner by the action of magnesium methyl iodide ethyl β-acetylglutarate is converted into ethyl terpenylate.

$$CO_2Et\cdot CH_2\cdot CHAc\cdot CH_2\cdot CO_2Et \longrightarrow CO_2Et\cdot CH_2\cdot CH\langle \begin{matrix} CH_2-CO \\ CMe_2\cdot O \end{matrix}.$$

When the sodium derivative of ethyl acetylsuccinate is treated with ethyl β-iodopropionate, ethyl β-acetylbutane-αβδ-tricarboxylate, $CO_2Et\cdot CH_2\cdot CH_2\cdot CAc(CO_2Et)\cdot CH_2\cdot CO_2Et$, boiling at 200—201°/14 mm. is obtained.

This ester, when hydrolysed with concentrated hydrochloric acid, gives β-acetyladipic acid, $CO_2H\cdot CH_2\cdot CH_2\cdot CHAc\cdot CH_2\cdot CO_2H$, which melts at 102° and yields an ethyl ester boiling at 179°/18 mm. which, when treated with magnesium methyl iodide, is converted into homoterpenylic ester.

$$CO_2Et\cdot CH_2\cdot CH_2\cdot CHAc\cdot CH_2\cdot CO_2Et \longrightarrow$$
$$CO_2Et\cdot CH_2\cdot CH_2\cdot CH\langle \begin{matrix} CH_2-CO \\ CMe_2\cdot O \end{matrix}$$

This, on hydrolysis, yields homoterpenylic acid (m. p. 100—101°), which is identical with the homoterpenylic acid obtained by Baeyer (*Ber.*, 1896, **29**, 1919) by the oxidation of pinene.

219. "Influence of light on diazo-reactions. Part I." By Kennedy Joseph Previté Orton, Joseph Edward Coates (and, in part, Frances Burdett).

Solutions of diazonium salts in water, methyl or ethyl alcohol, acetic or formic acid, decompose rapidly on exposure to light, although in many cases they may be preserved for long periods if kept in the dark (compare *Proc.*, 1905, **21**, 168).

The product of the reaction depends on the solvent; in aqueous solution a phenol is formed; in methyl or ethyl alcohols, the corresponding phenyl, methyl, or ethyl ether is mainly produced, in some cases a certain amount of the diazonium salt being at the same time converted into hydrocarbon (replacement of the diazo-group by hydrogen); in acetic acid solution, a phenyl acetate is the sole product, but in formic acid, the change follows the equation: $Ar{\cdot}N(X){:}N + H{\cdot}CO_2H = ArH + N_2 + CO_2 + HX$.

In most cases these reactions are quantitative; further, many diazo-compounds, which do not yield phenols, ethers, or phenyl acetates (for example, *s*-tribromodiazobenzene), when solutions in the appropriate solvents are heated, can be readily induced by light to undergo these changes.

Solutions of diazotates (*iso*diazotates) are not affected by light.

High concentrations of acid (for example 25 per cent. sulphuric acid) do not appreciably affect the rate of decomposition of the diazonium salts. Exposure to light of solutions of diazonium sulphates in 95 per cent. sulphuric acid brings about a conversion into the corresponding phenol.

These facts would appear to render untenable the view (Hantzsch) that phenols are formed from *syn*-diazohydroxides, since it is difficult to see how in such strongly acid solutions there can be any hydrolysis of the diazonium salt and consequent formation of the diazonium hydroxide to allow of their presence, thus:

$$Ar{\cdot}N(OH){:}N \rightleftharpoons \begin{matrix} Ar{\cdot}N \\ \| \\ HO{\cdot}N \end{matrix}$$

220. "The viscosity of liquid mixtures." By Albert Ernest Dunstan and Robert William Wilson.

In continuation of previous work on this subject the authors have investigated the viscosity concentration curve of mixtures of water and sulphuric acid.

They find a well-defined maximum point corresponding with H_2SO_4,H_2O, and a minimum corresponding with $3H_2SO_4,2H_2O$.

The general behaviour of solutions from the point of view of viscosity was discussed and it was shown how, from a knowledge of the viscosity and the chemical series to which it belongs, it is possible to determine the molecular weight of a liquid.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

British Association for the Advancement of Science. Report of the sixth meeting, 1836. London 1837. (*Reference.*)

From the Lawes Agricultural Trust.

Cross, *Charles Frederick,* and **Bevan,** *Edward John.* Researches on cellulose. II. (1900—1905.) pp. xi + 184. London 1906. (*Recd.* 26/11/06.)

From the Authors.

Koenigsberger, *Leo.* Hermann von Helmholtz. Translated by *Frances A.* **Welby.** With a preface by Lord Kelvin. pp. xviii + 440. ill. Oxford 1906. (*Recd.* 19/11/96.)

From the Delegates of the Clarendon Press.

II. *By Purchase.*

Blair, *Andrew Alexander.* The chemical analysis of iron. A complete account of all the best known methods for the analysis of iron, steel, pig-iron, iron ore, limestone, slag, clay, sand, coal, coke, and furnace and producer gases. 6th edition. pp. xix + 328. ill. Philadelphia 1906. (*Recd.* 20/11/06.)

III. *Pamphlets.*

Benedicks, *Carl.* Umwandlung des Feldspats in Sericit (Kaliglimmer). (From the *Bull. Geol. Inst. Upsala,* **7**, 1906.).

—— Yttriumhaltiger Mangangranat. (From the *Bull. Geol. Inst. Upsala,* **7**, 1906.)

—— Über das Gleichgewicht und die Erstarrungsstrukturen des Systems Eisen-Kohlenstoff. (From *Metallurgie,* **3**, 1906.)

Hersey, *Edmund.* A field experiment to test the merits of phosphate, potash, and nitrogen on a fine sandy loam of peculiar character. (From the *Bull. Bussey Inst.,* **3**, 1906.)

Reade, *T. Mellard*, and **Holland**, *Philip*. Sands and sediments. Part III. Final. (From the *Proc. Liverpool Geol. Soc.*, 1905—1906).

Roberts, *Edwin G. Ll.*, and **Wraight**, *Ernest A*. The preparation of carbon-free ferro-manganese. (From the *J. Iron and Steel Inst.*, 1906. II.)

ERRATUM.

PROCEEDINGS, 1906, No. 313, p. 206.

Line 7 from top, *for* "4" *read* "40."

At the next Ordinary Meeting, on **Thursday**, December **20th**, 1906, the following papers will be communicated:

"A new laboratory method for the preparation of hydrogen sulphide." By F. R. L. Wilson.

"The reaction of acids with methyl orange." By V. H. Veley.

"Contributions to the study of the calcium phosphates. I. The hydrates of the calcium hydrogen orthophosphates." By H. Bassett, jun.

"Contributions to the study of the calcium phosphates. II. The action of ammonia gas on the calcium hydrogen orthophosphates." By H. Bassett, jun.

"Relation between chemical constitution and physiological action in the tropeines." By H. A. D. Jowett and F. L. Pyman.

"Some derivatives of salicylic acid." By H. A. D. Jowett and F. L. Pyman.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 318.

Thursday, December 20th, 1906, at 8.30 p.m., Professor R. MELDOLA, F.R.S., President, in the Chair.

The PRESIDENT announced that the following congratulatory telegram had been sent this day to Prof. Adolph Lieben (Honorary and Foreign Member of the Society), on the occasion of his seventieth birthday and the fiftieth anniversary of his Doctorate.

"Hearty congratulations to our Honorary and Foreign Member, Dr. Adolph Lieben, from the Chemical Society, London.

"MELDOLA,
"*President.*"

Messrs. W. R. S. Ladell, W. T. Lattey, and J. Mastin were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.:

Alfred Frederick Allen, B.Sc., 35, Purrett Road, Plumstead, S.E.
Henry Bassett, jun., B.Sc., Ph.D., 26, Belitha Villas, Barnsbury, N.
John Christie, B.A., Eton College, Windsor.
Francis Davidson, Dover Place, Ashford, Kent.
William Smith Denham, B.Sc., 2, Kelvinside Terrace North, Glasgow.
George Fowles, 28, Weltje Road, Hammersmith, W.
William Godden, B.Sc., Station Road (East), Canterbury.
Charles Pask Matthews, B.Sc., 6, Fortress Road, N.W.
Charles Schlienger, B.Sc., 273, Camden Road, N.
William George Sewell, B.Sc., 27, Park Road, Wandsworth Common, S.W.
Frederick George Shepheard, B.Sc., 9, Leinster Road, Rathmines, Co. Dublin.

Of the following papers, those marked * were read :

***221. "A new laboratory method for the preparation of hydrogen sulphide." By Frederick Robert Leyland Wilson.**

The common method for the preparation of hydrogen sulphide by the interaction of hydrochloric acid and ferrous sulphide is open to several objections, the most serious of which is the liability of the gas to contain the hydrides of arsenic and phosphorus, due to the contamination of the iron sulphide with phosphide and arsenide. The method here described ensures freedom from these impurities, as well as the absence of most of the unpleasant accompaniments of the ordinary process of preparation.

If a current of hydrogen sulphide is passed over an alkali hydroxide, for example, sodium or calcium hydroxides, a hydrosulphide is formed, heat being evolved and a change in colour from white to yellow taking place. If a current of carbon dioxide is now passed over the hydrosulphide, the compound is at once decomposed, a carbonate being formed and hydrogen sulphide set free.

In the case of calcium hydroxide, the yellow substance has the composition Ca(HS)(OH), and the action of carbon dioxide is given by the equation $Ca(HS)(OH) + CO_2 = CaCO_3 + H_2O + H_2S$.

A drying tower is filled either with granular soda-lime or an intimate mixture of calcium hydroxide and moist sawdust. A stream of hydrogen sulphide is passed into the tower until the contents are saturated with the gas, the course of the action being easily determined by the change in colour and by the movement of a heated zone upwards through the tower.

After the action has proceeded for some time the gas which escapes from the exit tube smells strongly of hydrogen phosphide and is inflammable, doubtless consisting of hydrogen mixed with all the other gaseous impurities evolved by the action of acid on the ferrous sulphide.

When the hydroxide has reacted with as much hydrogen sulphide as possible, a carbon dioxide generator is substituted for that supplying hydrogen sulphide, and the apparatus is ready to yield as slow or rapid a supply of the latter gas as may be desired.

The supply of hydrogen sulphide ceases at once when the stream of carbon dioxide is cut off, and if the exit tube from the tower is closed, a partial vacuum will soon be produced owing to combination of the gases in the tower with unaltered hydroxide.

Owing to this absorption of the gas in the tower, it is only necessary to cut off the supply of carbon dioxide in order to prevent further escape of hydrogen sulphide.

The rate of supply of the gas may be nicely regulated by introducing a short length of capillary glass tubing between the carbon dioxide apparatus and the generating tower.

The danger of contamination of the hydrogen sulphide with carbon dioxide is very small, and may be entirely eliminated by making use of two towers. As soon as the first shows signs of exhaustion (indicated when calcium hydroxide is used, by the change in colour) it is replaced by the second tower; a new one is put in place of the latter, and the supply of gas taken from this.

Discussion.

The President asked how the method compared with the known laboratory process of preparing hydrogen sulphide by heating sulphur with certain hydrocarbons such as solid paraffin.

Mr. Wilson stated that he had not compared the two methods.

***222. "The affinity constants of aminocarboxylic and aminosulphonic acids as determined by the aid of methyl-orange." By Victor Herbert Veley.**

The method of determining the affinity constants of acids by means of a very dilute methyl-orange solution and a tintometer described in a former paper (*Zeit. physikal. Chem.*, 1906, **57**, 147), as applied to the carboxylic acids and certain chloro- and hydroxy-derivatives, has been extended to the aminocarboxylic and aminosulphonic acids. It is shown that the same general mathematical expressions hold good, namely, those of straight lines $y = kx$ or $y = kx - b$, or logarithmic curves $\log y = \log k + x \log a$.

Acids which show irregularities in the Ostwald electric conductivity expression $\phi(k) = a^2/(1-a)V.(a = \mu/\mu_\infty)$ likewise show similar irregularities in the methyl-orange method.

The aliphatic aminocarboxylic acids act as neutral substances, but their hydrochlorides as hydrochloric acid only, hydrolysis being nearly complete at the degree of dilution used.

The special cases of asparaginic acid, as possessing a higher affinity factor than succinic acid, and of cacodylic acid, as allied to amphoteric electrolytes, have been investigated.

The aminobenzoic acids show a distinct acid function, and the results obtained are in a similar arithmetical ratio to those deduced by Winkelblech (at a different degree of dilution) by the electric conductivity method.

The two aminobenzenesulphonic acids studied, namely, sulphanilic (1 : 4) and metanilic (1 : 3) acids are remarkable in that the latter

conforms to the straight line, but the former to the logarithmic expression.

The introduction of a second sulphonic grouping diminishes rather than increases the acid function.

A study of the naphthylamine mono- and di-sulphonic acids (eighteen in number) affords examples of steric "furtherance" as regards the positions 2 and 7 relative to 1, and of steric hindrance as regards the position 8 relative to all other positions.

Discussion.

Dr. Cain suggested that, as the 1-naphthylamine-8-sulphonic acid exhibited the phenomenon of "steric hindrance" and the 1-naphthylamine-2-sulphonic acid that of "steric furtherance," it would be of interest to know the behaviour of the 1-naphthylamine-4-sulphonic acid, particularly as this underwent molecular change into the 1 : 2-acid by the action of heat.

Dr. Hewitt asked if there was any definite stage between the colour of methyl-orange in alkaline and in acid solution. He had himself compared the absorptions of methyl-orange and butter-yellow, and found that the solutions of dimethylaminoazobenzene and sodium dimethylaminoazobenzenesulphonate on the one hand, and the salts of butter-yellow and acidified solutions of methyl-orange on the other gave practically identical absorption spectra. Any intermediate coloration between that of the free sulphonic acid and its sodium salt might be explained by partial neutralisation, and this opinion is confirmed by the fact that dimethylaminoazobenzenesulphonic acid in solution gives practically the same absorption as solutions of methyl-orange with an excess of mineral acid. The supposed free acid of methyl-orange would thus appear to be an internal salt.

The President asked whether special precautions had been taken to ensure the purity of the naphthylaminesulphonic acids used by the author, since the technical preparations supplied were professedly impure from the chemical point of view, and the difficulty of obtaining homogeneous products from mixtures of isomerides was often very great. With respect to the question of the proximity of position 8 as compared with position 2 relatively to position 1 in the naphthalene ring, he did not think that enough was known about the actual configuration of the atoms in the molecule to enable any dogmatic statement to be made.

Dr. Veley, in reply, said that it would be unwise to express any dogmatic views as to the relative contiguity of substituent groupings in the naphthalene nucleus. As regards the position 4, a difficulty had arisen on account of the sparing solubility of the

1-naphthylamine-4-sulphonic acid. The acids had been purified previous to use by recrystallisation or otherwise. He felt some hesitation in discussing the actual composition of the yellow, orange-red, and red shades of methyl-orange, but it was clear that the last was the result of some more profound chemical change. In any case the hypothesis of migratory ions appeared to be too speculative.

***223. "Contributions to the study of the calcium phosphates. I. The hydrates of the calcium hydrogen orthophosphates." By Henry Bassett, jun.**

Although numerous hydrates of dicalcium phosphate have been mentioned in the chemical literature, the author's experiments show that, in all probability, dicalcium phosphate can only form one hydrate, namely, the dihydrate.

The experiments also allow of some conclusions being drawn as to the position of certain of the quintuple points on the space model of the three-component system, $CaO—P_2O_5—H_2O$.

There are indications that the point at which the phases present are $CaHPO_4,2H_2O$; $CaHPO_4$; solid solution (see the papers by Cameron and Seidell in *J. Amer. Chem. Soc.*, 1905, **27**, 1503, and Cameron and Bell, *J. Amer. Chem. Soc.*, 1905, **27**, 1513); liquid solution and vapour lies at about 80°; whilst the point at which the phases $CaH_4(PO_4)_2,H_2O$; $CaHPO_4,2H_2O$; $CaHPO_4$; liquid solution and vapour can coexist lies at about 30°.

The monocalcium phosphate has also been studied, and it has been found possible to prepare the crystallised anhydrous salt. This compound can be obtained in long, bright prisms by crystallisation at 160° of a solution of calcium carbonate in orthophosphoric acid if the ratio of P_2O_5/CaO in the solution is sufficiently large. The best value for this ratio was found to be 4·6. If it is less than 3·0, then, even at 160°, the monocalcium phosphate monohydrate crystallises out.

***224. "Contributions to the study of the calcium phosphates. II. The action of ammonia gas on the calcium hydrogen orthophosphates." By Henry Bassett, jun.**

It was found that under certain conditions when the acid calcium phosphates were treated with ammonia gas, absorption of the latter took place. The cause of this and the reactions occurring have been investigated with the following results:

$CaHPO_4$ does not absorb ammonia either at the ordinary temperature or at 100°.

$CaHPO_4,2H_2O$ does not absorb ammonia at the ordinary tempera-

ture, but if heated in the gas to 100°, vigorous absorption takes place with formation of a mixture of tricalcium- and ammonium phosphates according to the equation:

$$3CaHPO_4,2H_2O + 2NH_3 = Ca_3(PO_4)_2 + (NH_4)_2HPO_4 + 6H_2O.$$

When $CaHPO_4,2H_2O$ is heated, it would seem that at a temperature of about 80°, one of the quintuple points of the system $CaO - P_2O_5 - H_2O$ is reached. At this temperature the dihydrate breaks up into a mixture of $CaHPO_4$,$Ca_3(PO_4)_2$ and solution, and it is in this solution that the above reaction with ammonia takes place.

$CaH_4(PO_4)_2$ absorbs ammonia very slowly at the ordinary temperature, but rapidly at 100° with formation of the compound $Ca(NH_4)_2H_2(PO_4)_2$. This compound is not stable in presence of water, which at once decomposes it into $CaHPO_4$ and $(NH_4)_2HPO_4$. This explains why, when $CaH_4(PO_4)_2H_2O$ reacts with ammonia gas, a mixture of $CaHPO_4$, $Ca_3(PO_4)_2$, and $(NH_4)_2HPO_4$ is formed.

The commencement of the ammonia absorption by the $CaH_4(PO_4)_2,H_2O$, is probably due to formation of the above calcium ammonium phosphate. This, however, liberates water of crystallisation, which at once forms some solution in which the reaction proceeds. Although this reaction first leads to the formation of $CaHPO_4$, this can further react with ammonia as long as any solution is present.

It is to this further reaction that the presence of $Ca_3(PO_4)_2$ in the final product is due.

Discussion.

Dr. Veley asked if the author had dried the ammonia gas, and if the phosphates experimented upon were quite free from traces of adherent moisture. It appeared that the subsequent solution in water of the products obtained introduced a very essential disturbing factor.

Dr. Bassett, in reply, said that the ammonia used had been dried by passing over solid caustic soda and sodium wire, but, of course, such ammonia was not absolutely dry. The calcium phosphates used in the experiments were also as free from adherent moisture as was possible without extreme precautions. With regard to the examination of the reaction products by treatment with water, the author realised the dangers of the method and the possibility of reactions occurring during this treatment. The method had, however, been employed as being the only one which would enable one to distinguish between, for instance, a mixture of $Ca_3(PO_4)$ and $(NH_4)_2HPO_4$, and a compound $Ca(NH_4)PO_4$, and he considered that the difficulty caused by possible reactions during the extraction with water had been satisfactorily overcome in each particular case in the manner described in the paper.

***225. "Relation between chemical constitution and physiological action in the tropeines." By Hooper Albert Dickinson Jowett and Frank Lee Pyman.**

Reference was made to Ladenburg's generalisation, according to which a tropeine in order to possess mydriatic action must contain a benzene nucleus and a fatty hydroxyl in the side chain containing the carboxyl group, and also to a recent paper by Jowett and Hann (*Trans.*, 1906, **89**, 357), in which it was stated that terebyl- and phthalidecarboxyl-tropeines, which are lactones, and do not contain fatty hydroxyl groups, produce, nevertheless, marked dilatation of the pupil, and lose their physiological activity when converted into the corresponding hydroxy-acids.

The authors have prepared the *lactone* of *o-carboxyphenylglyceryltropeine*, expecting to find it very active physiologically, since it is not only a lactone, but also conforms to Ladenburg's generalisation, *isocoumarincarboxyltropeine* which results on heating the above, and certain alkyl bromides of these tropeines and of homatropine.

The physiological examination showed that these tropeines are only slightly mydriatic, and that their physiological activity is lost when they are converted into the corresponding hydroxy-acids. The authors conclude that Ladenburg's generalisation cannot be maintained since it does not hold good either in the case of terebyltropeine or of the lactone of *o*-carboxyphenylglyceryltropeine, but that the difference in activity between a lactone and its corresponding hydroxy-acid possesses important physiological significance.

226. "Some derivatives of salicylic acid." By Hooper Albert Dickinson Jowett and Frank Lee Pyman.

In the course of the production of some derivatives of salicylic acid which might possibly find application in medicine, *cinnamoylsalicylic acid*, its *methyl* and *ethyl esters*, and *quinine salt*, and also 3 : 5-*dichloroacetylsalicylic acid* were prepared and characterised.

Cinnamoylsalicylic Acid, $CO_2H \cdot C_6H_4 \cdot O \cdot CO \cdot CH{:}CHPh$.

Ten grams of salicylic acid and 12 grams of cinnamoyl chloride were heated together on a water-bath during three-and-a-half hours. The end of the reaction was indicated by the mixture becoming quite solid. After two recrystallisations from benzene, *cinnamoylsalicylic acid* was obtained in a pure state, and in quantity amounting to 48 per cent. of the theoretical yield; it crystallises from benzene in needles melting

at 155°: is very readily soluble in alcohol or ether, sparingly so in chloroform or benzene, and almost insoluble in water:

0·2409 gave 0·6316 CO_2 and 0·0981 H_2O. C = 71·5; H = 4·5.
$C_{16}H_{12}O_4$ requires C = 71·6; H = 4·5 per cent.

The *Quinine Salt*, $C_{16}H_{12}O_4,C_{20}H_{24}O_2N_2$, crystallises from alcohol in needles which melt at 169°. It is almost insoluble in water or cold alcohol:

0·2151 gave 0·5729 CO_2 and 0·1208 H_2O. C = 72·5; H = 6·2.
$C_{16}H_{12}O_4,C_{20}H_{24}O_2N_2$ requires C = 72·9; H = 6·1 per cent.

The *Methyl Ester* was prepared by the condensation of molecular quantities of cinnamoyl chloride and methyl salicylate by means of anhydrous potassium carbonate. The product was purified by first treating with hot water, dissolving in chloroform, drying this solution, and mixing the oil which resulted after the removal of the solvent with light petroleum. On then recrystallising from alcohol, the pure ester was obtained in large, tabular crystals melting at 71° and in an amount equal to 63 per cent. of the theoretical yield:

0·2320 gave 0·6144 CO_2 and 0·1049 H_2O. C = 72·2; H = 5·0.
$C_{17}H_{14}O_4$ requires C = 72·3; H = 5·0 per cent.

The *Ethyl Ester*, obtained in an analogous manner, crystallises from alcohol in fine needles melting at 66—67°:

0·2433 gave 0·6476 CO_2 and 0·1182 H_2O. C = 72·6; H = 5·4.
$C_{18}H_{16}O_4$ requires C = 72·9; H = 5·4 per cent.

3 : 5-*Dichloroacetylsalicylic Acid*, $C_9H_6O_4Cl_2$.

This substance was prepared by the acetylation of 3 : 5-dichlorosalicylic acid with acetic anhydride and sodium acetate. It crystallises from benzene in needles melting at 159°:

0·3350 gave 0·5328 CO_2 and 0·0732 H_2O. C = 43·4; H = 2·4.
0·2060 „ 0·2358 AgCl. Cl = 28·3.
$C_9H_6O_4Cl_2$ requires C = 43·4; H = 2·4; Cl = 28·5 per cent.

227. "The addition of bromine to cinnamic acid and its esters. Preliminary notice." By John Joseph Sudborough and John Thomas.

The appearance of a communication from W. Herz and Bruno Mylius in the last number of the *Berichte* (1906, 39, 3816) on the velocity of the addition of bromine to cinnamic acid induces us to give

a preliminary account of experiments made by us on the same subject. All our experiments were conducted in pure dry carbon tetrachloride at 15°. The bromine used was the commercial product dried with sulphuric acid. We find that the velocity varies enormously according as the reaction proceeds in the dark or in daylight.

The following numbers calculated by means of the equation for a bimolecular reaction, when molecular proportions of bromine and of cinnamic acid, namely, some 0·0333 mol. per litre, are used, show this clearly.

Cinnamic Acid.—K (in dark). Series 1 : 0·0054, 0·0044, 0·0066, 0·010, 0·013. Series 2 : 0·0072, 0·0074, 0·0066, 0·012.

K (in diffused daylight). Series 1 : 0·28, 0·33, 0·36, 0·33. Series 2 : 0·41, 0·37, 0·31, 0·34, 0·30, 0.31.

Similar results have been obtained when the methyl and ethyl esters are used.

Methyl ester.—K (in dark). Series 1 : 0·0058, 0·0060, 0·0058, 0·0089, 0·0089, 0·0081. Series 2 : 0·0047, 0·0047, 0·0039, 0·0062, 0·0089, 0·0071. Series 3 : 0·0049, 0·0091, 0·0071, 0·0079, 0·0095.

Ethyl ester.—K (in dark). Series 1 : 0·0085, 0·0074, 0·0077, 0·010, 0·011, 0·012. Series 2 : 0·0071, 0·0074, 0·0053, 0·0076, 0·012, 0·010 Series 3 : 0·0044, 0·0048, 0·0050, 0·0050, 0·0049.

(In diffused daylight) 0·29, 0·25, 0·25, 0·30. (In sunlight) 1·85, 1·70, 1·60, 1·29, 1·62, 1·49.

The velocity constant with crotonic acid is smaller than with cinnamic acid.

Crotonic acid (in dark) K = 0·00096, 0·00094, 0·00069, 0·00101.

All the experiments were made in glass-stoppered bottles, not in sealed tubes ; those conducted in the dark were in amber-brown coloured, the others in colourless bottles.

We wish to extend the work in the direction of studying the effect of the introduction of various substituents into the crotonic and cinnamic acid molecules.

228. "The optical and magneto-optical influence of ethenoid linkings attached to contiguous carbon atoms." By Julius Wilhelm Brühl.

It has been found by Sir W. H. Perkin that limonene and dipentene (I), and $\Delta^{3:8(9)}$-*p*-menthadiene (II).

(I.) (II.)

exhibit a remarkable difference in magnetic rotation, the values of (II) being much higher than those of (I). The author showed that this is

due to the presence of two double linkings in the position –C:C·C:C– in the molecule of $\Delta^{3:8(9)}$-*p*-menthadiene.

229. "A difficulty in the theory of valency of W. Barlow and W. J. Pope." By David Leonard Chapman.

In the last number of the Transactions (p. 1675), W. Barlow and W. J. Pope claim to have demonstrated that the doctrine of valency follows as a necessary consequence of certain simple assumptions as to the nature and mode of packing of the atoms. The consequences of the theory have not as yet been fully worked out; for the present, therefore, it will be best to restrict any remarks to an examination of the premisses. An analysis of these has disclosed a difficulty which appears to be of importance and to necessitate some modification of the fundamental assumptions.

In the paper in question the following is laid down as the first geometrical property of spheres: "If in a close-packed assemblage of spheres, single spheres or groups of two or more, selected homogeneously, are replaced homogeneously by other groups of spheres in such a way that the resulting assemblage is close-packed without resorting to remarshalling, the replacing group is of practically the same relative magnitude as the group replaced, and possesses the same fundamental valency" (*Trans.*, p. 1724).

A second geometrical property is stated thus: "If a sphere of volume m (an atom of valency m) is replaced by one of volume $m + n$ (valency $m + n$) one or more additional spheres (atoms) having the total volume n (valency n) must be simultaneously inserted in order that the close-packing may be re-established without remarshalling" (*Trans.*, p. 1729—1730).

It is declared that from these propositions the law of the equivalence of elements and compound radicles can be immediately deduced, and the fact that an element of fundamental valency m can function as one of valency $m + 2n$ is said to receive by means of them a rational explanation.

It will now be shown that different results can be deduced from the propositions in question. Consider a close-packed homogeneous assemblage, the similar parts of which are built up of spheres of the relative volumes

$$2n_1,\ 2n_2 \ldots\ldots\ldots 2n_n,\ 2\ ;$$

where n_1, n_2, &c., are whole numbers.

Replace the sphere of volume 2 by two spheres each of volume 1. According to the geometrical property of spheres formulated first above, this can be done without remarshalling being involved. Now replace

one of the spheres of volume 1 by two spheres of respective volumes 2 and 1, and finally replace the two spheres of unit volume by a single sphere of volume 2. The original system has now been converted into one composed of spheres of volumes represented by the numbers

$$2n_1,\ 2n_2 \ldots\ldots\ldots\ldots 2n_n,\ 2,\ 2$$

without remarshalling, and by three substitutions in two of which the first geometrical property and in one of which the second geometrical property have been assumed to hold.

Now we are not concerned with the absolute dimensions of the system, and therefore the initial group of spheres can be regarded as consisting of spheres of the volumes

$$n_1,\ n_2 \ldots\ldots\ldots\ldots n_n,\ 1,$$

and the final group of spheres can be regarded as consisting of spheres of the volumes

$$n_1,\ n_2 \ldots\ldots\ldots\ldots n_n,\ 1,\ 1,$$

the marshalling being the same in both cases.

Therefore two spheres of volume 1 can function as one sphere of volume 1. By similar reasoning it can be shown that a sphere of volume 2 can function as a sphere of volume 1, and in general that a sphere of any size can replace any other without any resort to remarshalling being necessary.

From the foregoing argument it would appear that the two propositions quoted above cannot be used alone (in their present unqualified form at any rate) to demonstrate that valency is a simple volume relation. A formal statement, from the authors, of the restrictions to be put upon their use would be of value.

230. "On the more exact determination of the densities of crystals." By the Earl of Berkeley.

A conical pyknometer with thermometer stopper and graduated side tube is used, and instead of filling to a mark, the author relies on the evaporation of the liquid (round the neck) to bring the level in the capillary side-tube within the graduations.

The liquid used is carbon tetrachloride, and care is taken that the temperature of the balance case varies but little while the pyknometer is being weighed.

The air adhering to the crystals is expelled by causing a current of carbon tetrachloride vapour to pass over them when in an exhausted vessel, and the pyknometer is filled while still in this vacuous space. A desiccator was described whereby hygroscopic salts may be dried in

a current of hot air, and the pyknometer filled in a vacuum. Results for the density of quartz, barytes, and potassium carbonate were given. The maximum difference between any two observations out of eleven on quartz, and out of nine on barytes, is 0·02 per cent. The experiments on potassium carbonate do not agree so closely.

231. "A relation between the volumes of the atoms of certain compounds at the melting points and their valencies. Interpretation by means of the Barlow-Pope theory." By Gervaise Le Bas.

The molecular volumes of complex paraffins and alcohols can be calculated very exactly by means of the formula:

$$\text{M. V. of } C_nH_{2n+2} = (6n+2)S = 6nS + 2S,$$

where S is a constant which has an average value of 2·970 and is called the unit-stere. It is a measure of the volume of hydrogen. Carbon, in accordance with its valency, is equal to 4S. The value of S is also obtained by dividing the difference for CH_2 by 6. The numbers obtained in this way confirm the previous values.

Certain alcohols up to heptadecyl carbinol, $C_{18}H_{37}OH$, have also been studied and their volumes are calculated by means of the expression

$$\text{M. V. of } C_nH_{2n+1}OH = (6n+4)S = 6nS + 4S,$$

S having the same value as in the former series. Oxygen is thus found to have a volume equal to 2S in accordance with its valency-number.

These results were discussed in the light of the Barlow-Pope theory (*Trans.*, 1906, **89**, 1675).

232. "The action of acid chlorides on thioureas." By Augustus Edward Dixon and John Hawthorne.

In former communications it has been shown that alkyl and aryl chlorocarbonates unite with thiourea, forming the hydrochlorides of basic derivatives, or pseudo-thioureas, $NH_2 \cdot C(NH) \cdot S \cdot CO_2 \cdot R$; it is now established that Claus' compound of thiourea and acetyl chloride (*Ber.*, 1875, **8**, 42) is similarly constituted.

Acetyl chloride unites spontaneously with monosubstituted aryl-thioureas, yielding compounds of the form

$$ArNH \cdot C(NH) \cdot S \cdot COMe, HCl;$$

from these the corresponding picrates may be prepared. On withdrawing the combined hydrochloric acid by calcium carbonate or sodium ethoxide, the odour of thioacetic acid becomes perceptible;

hence the base is probably liberated and then hydrolysed to a slight extent. Nevertheless, the product left on evaporation of the solution is not the free base, but an isomeride, the acetyl group having migrated from the sulphur to a nitrogen-atom, so as to yield

$$AcArN{\cdot}CS{\cdot}NH_2.$$

The latter compound is known to change readily, by migration of its acyl group, into another isomeride, namely, the symmetrical AcNH·CS·NHAr: it appears, therefore, that by this series of transfers the acetyl group may be passed, in a given thiourea molecule, from point to point, until it has occupied, in succession, every position of attachment which a substituting group can assume. If the hydrogen chloride is eliminated by heat alone, the symmetrical or *ab*-thiocarbamide is produced; in like manner, Claus' compound yields acetylthiourea.

Benzoyl chloride behaves with thiourea and its aryl monosubstitution derivatives similarly to acetyl chloride; both chlorides unite with *ab*-aryl disubstituted thiocarbamides to form molecular additive products, the constitution of which has not yet been determined.

Disubstituted carbamic chlorides unite with thiourea, forming haloid salts; the corresponding nitrates and picrates are sparingly soluble in water.

Organic acid chlorides do not appear to combine with thioureas which already contain an acidic group.

233. "3-Hydroxyphthalic and 3-methoxyphthalic acids and their derivatives." By William Henry Bentley, Rona Robinson, and Charles Weizmann.

An account was given of the preparation of 3-methoxyphthalic acid by the oxidation of 1 : 5-methoxynaphthol with alkaline permanganate, and of 3-hydroxyphthalic acid by fusion of 3-methoxyphthalic acid with caustic potash. A number of derivatives of each acid were described.

234. "4-Hydroxyphthalic and 4-methoxyphthalic acids." By William Henry Bentley and Charles Weizmann.

The preparation of pure 4-hydroxyphthalic acid (m.p. 205°) from sulphophthalic acid by fusion with caustic potash was described, together with a number of derivatives of this acid.

235. "Derivatives of Naphthacenequinone." By William Henry Bentley, Arthur Friedl, Frederick Thomas, and Charles Weizmann.

This paper is a fifth contribution to the Chemistry of naphthacenequinone (compare Diechler and Weizmann, Orchardson and Weizmann, *Ber.*, 1903, **36**, 547, 719, 2326; *Trans.*, 1906, **89**, 116), and contains a description of the preparation and properties of a large number of new hydroxy- and aminohydroxy-derivatives of this series.

236. "Dithioxanthoxalanil (Preliminary note)." By Siegfried Ruhemann.

Thioacetanilide reacts with ethyl oxalate in the presence of sodium ethoxide to yield a compound similar to those which are formed from acetanilide and its homologues (Ruhemann, *Trans.*, 1906, **89**, 1236; *Proc.*, 1906, **22**, 284).

Dithioxanthoxalanil, $PhN<\begin{matrix}CS\cdot CH_2 & CO\cdot CO\\ CO\cdot C & C-CS\end{matrix}>NPh$, crystallises from glacial acetic acid in brown needles which decompose at about 235°. It differs from xanthoxalanil inasmuch as it is more stable towards caustic potash. The dilute alkali, or sodium carbonate, dissolves it on warming and transforms it into its *tautomeride*, $PhN<\begin{matrix}C(SH):CH & CO\cdot CO\\ CO-C & C-CS\end{matrix}>NPh$, which crystallises from alcohol in red needles decomposing at 195°, and is soluble in cold sodium carbonate. On boiling with caustic potash (10 to 15 per cent.) one atom of sulphur is removed as hydrogen sulphide, and replaced by oxygen; the compound, *thioxanthoxalanil*, which is thus formed, crystallises from alcohol in shiny, orange plates which decompose at 216—218°, and are soluble in sodium carbonate. The constitution of this substance is either

$PhN<\begin{matrix}C(SH):CH & CO\cdot CO\\ CO-C & C-CO\end{matrix}>NPh$, or

$PhN<\begin{matrix}C(OH):CH & CO\cdot CO\\ CO-C & C-CS\end{matrix}>NPh$;

it is only decomposed by being heated with concentrated caustic potash (60 to 70 per cent.), when oxalic acid and aniline are formed.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Roscoe, *Sir Henry Enfield.* The life and experiences of Sir Henry Enfield Roscoe, D.C.L., LL.D., F.R.S. Written by himself. pp. xii + 420. ill. London 1906. (*Recd.* 17/12/06.) From the Author.

Titherley, *Arthur W.* A laboratory course of organic chemistry, including qualitative organic analysis. pp. viii + 235. ill. London 1906. (*Recd.* 19/12/06.) From the Author.

Tschirch, *Alexander.* Die Harze und die Harzbehälter mit Einschluss der Milchsäfte. Historisch-kritische und experimentelle, in Gemeinschaft mit zahlreichen Mitarbeitern ausgeführte Untersuchungen. 2 Auflage. 2 vols. pp. xxii + 1268. ill. Leipzig 1906. (*Recd.* 28/11/09.)

From the Publishers: Gebrüder Borntraeger.

II. *By Purchase.*

Groth, *Paul Heinrich.* Chemische Krystallographie. Teil I. Elemente. Anorganische Verbindungen ohne Salzcharakter. Einfache und complexe Halogenide, Cyanide und Azide der Metalle, nebst den zugehörigen Alkylverbindungen. pp. viii + 626. Leipzig 1906. (*Recd.* 19/12/06.)

Post, *Julius.* Chemisch-technische Analyse. Handbuch der analytischen Untersuchungen zur Beaufsichtigung chemischer Betriebe. 3 Auflage. Bände I. i. und II. i. pp. 180, 208. ill. Braunschweig 1906. (*Recd.* 19/12/06.)

Procter, *Henry Richardson.* The principles of leather manufacture pp. xvi + 512. ill. London 1903. (*Recd.* 6/12/06.)

III. *Pamphlets.*

Blount, *Bertram.* Recent progress in the cement industry. A paper read before the Society of Chemical Industry on June 11th, 1906. pp. 48.

White, *Americus Frederic.* Composition of the waters of Rockbridge County, Virginia, and their relation to the geological formations. pp. 38. Winchester, Va. 1906.

At the next Ordinary Meeting, on **Thursday**, January **17th**, 1907, the following papers will be communicated :

"The relation between absorption spectra and optical rotatory power. Part I. The effect of unsaturation and stereo-isomerism." By A. W. Stewart.

"Organic derivatives of silicon. Part II. The synthesis of *dl*-benzylethylpropylsilicol, its sulphonation, and the resolution of the sulphonic derivatives into optically active components." By F. S. Kipping.

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